INSIDE: UNEARTHING STATE PARK SECRETS

Montana Outdoors

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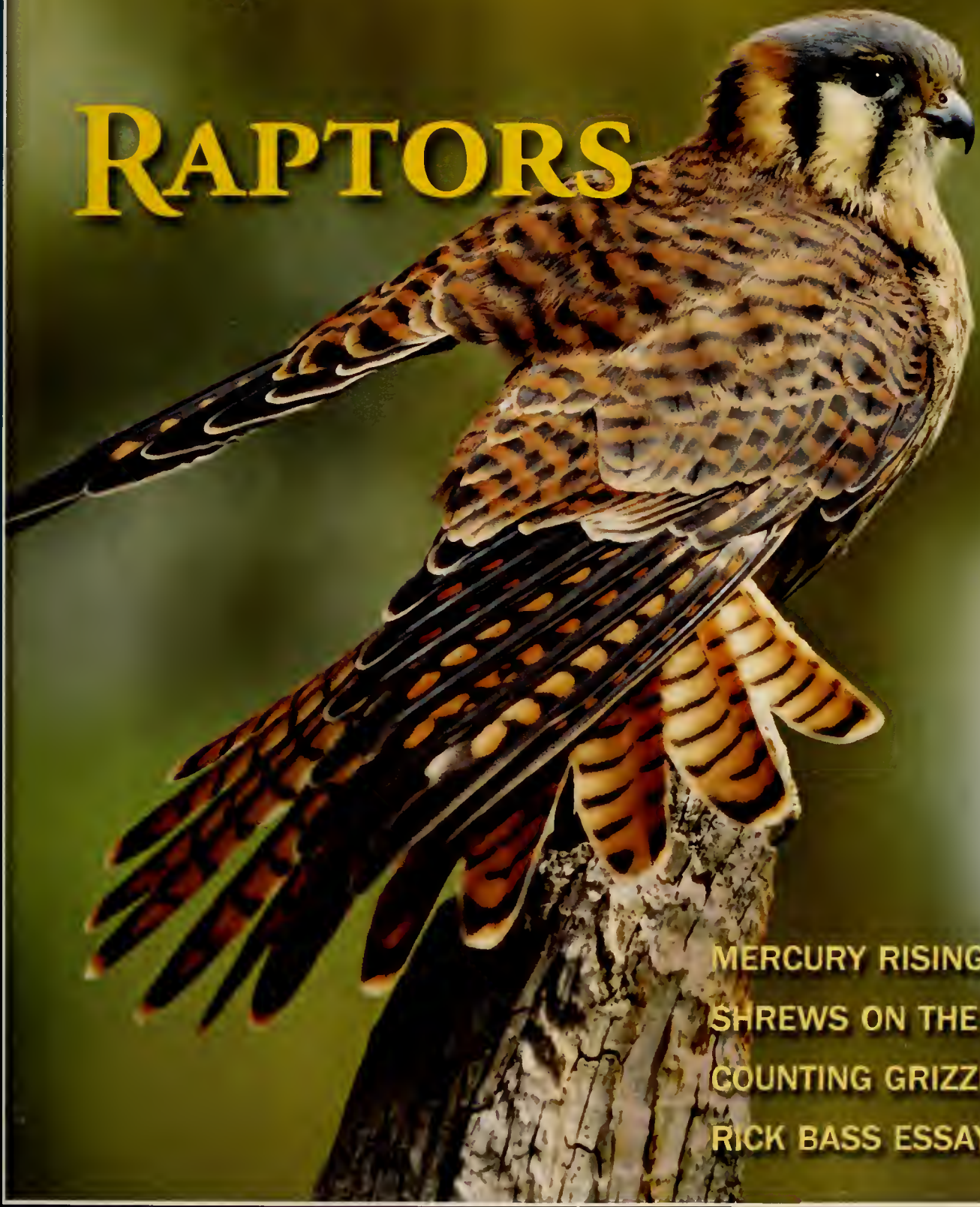
MARCH–APRIL 2009



RAPTORS

MERCURY RISING

SHREWS ON THE PROWL

COUNTING GRIZZLIES

RICK BASS ESSAY

Montana Fish, Wildlife & Parks

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MINIATURE MENACE A vagrant shrew eats its weight in butterflies and other insects each day. See why on page 36. Photo by Alex Badyaev.

FRONT COVER What has FWP learned from three decades of surveying American kestrels and other raptors? Find out on page 30. Photo by Denver Bryan.

Montana Outdoors

MARCH–APRIL 2009

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What exactly is venison?

In the cooking article ("24-Carat Venison," November–December), you've got pronghorn included with elk and deer. I always thought venison was just deer meat.

Mark Sanders
Spokane, WA

Venison is a culinary term for the meat of cervids, or members of the deer family, such as elk, deer, and moose. Though not a member of the deer family, the pronghorn has meat similar in taste and texture and is often grouped with cervids in discussions about venison cuisine.

Sending a dangerous message

The Parting Shot picture on the back cover of the November–December issue left me a little concerned. The regulations require that a hunter wear a minimum of 400 square inches of blaze orange above the waist, "visible at all times" when hunting big game during the rifle season. If the hunter depicted in the photo is wearing any blaze orange, it is not visible with the large camouflage pack on his back. On opening day of the big game season last fall, I came upon a hunter wearing his reversible blaze orange jacket with the orange on the inside, where it wasn't visible. I told him that wasn't legal, but after seeing the picture on the back cover of *Montana Outdoors*, I can understand where people might get the idea that it is. Scenic pictures are nice, but hunters in those pictures should be portrayed as ethical and law abiding.

Ron Hvizdak
Eureka

We received many comments from readers and game wardens pointing out our error.

Hounds are helpful

Your article on cougars ("A Close Look at Mountain Lions," July–August) is most relevant to the problems we are having in Oregon. Hound hunting has been essentially banned here for a number of years, which has resulted in large increases in cougar populations and corresponding reductions in the deer herds in areas with high cougar populations. The findings of the Rich DeSimone study that hound hunting could result in much better cougar population control could be a better solution than having to hire professional hunters in problem areas, which is what Oregon is now forced to do.

Trenor Scott
Grants Pass, Oregon

Longbow hunters deserve more days afield

As a nonresident Montana bowhunter, I read with great interest "A Boom in a Silent Sport" (September–October). I was very pleased to see that the author touched on technology as being part of the problem of high harvest. Most bowhunters are not using what Robin Hood used. Technology has reduced the skill required by bowhunters while increasing harvest rates. Numbers and days afield of high-tech bowhunters should be lowered by FWP to compensate. It's time to redefine weapons and their seasons to acknowledge the challenge of true archery hunting and the much lower harvest rates that come with it. A bowhunter using a compound bow lethal to 50 yards, carbon-shaft arrows, and a laser range finder does not deserve the same number of days afield as a bowhunter using a longbow with a 15-yard range and wooden arrows.

Jeff Morrison
Mount Morris, PA

Job well done

I recently received my first issue of *Montana Outdoors*. The article I read on female game wardens ("The Changing Face of Game Law Enforcement," November–December) inspired me to write. For the youth waterfowl season, I took two teens and their father out for their first duck hunt. In our search for ducks, we ended up at the Blackbird Fishing Access Site on the lower Madison River near Three Forks. After an unsuccessful attempt to shoot some mallards and teal, we returned to our vehicle and were approached by a female and a male warden. They talked to the teens about hunting and treated all of us as sportsmen enjoying the outdoors rather than as potential game violators. The wardens might believe they were just "doing their jobs," but they displayed a positive and professional example for the kids. I'd like to apologize for not catching their names, but I hope they read this and know they are appreciated.

Jamie Young
Belgrade

Painless subscription

I was at the dentist's office awaiting my turn in the chair when I spotted a copy of your magazine on the table and immediately began reading it. I was so impressed I ordered a three-year subscription, as I believe the price of your publication will only be going up in the near future, and I wanted to capitalize on this great deal. If you had a lifetime subscription, I would sign up today. Keep up the good work and thanks for producing such a wonderful product.

Paul Linnell
Scobey

We welcome comments, questions, and letters to the editor. We'll edit letters as needed for style and length. Reach us at *Montana Outdoors*, P.O. Box 200701, Helena, MT 59620-0701, or tdickson@mt.gov

"I told you we overbuilt."

A Brief Introduction

MONTANA FWP

As the new acting director of Montana Fish, Wildlife & Parks, I would like to take this opportunity to introduce myself to *Montana Outdoors* readers.

First, let me say that it is an honor to be part of this great department. Montana is a state blessed with extraordinary fisheries, wildlife populations, landscapes, river systems, and state parks. Providing stewardship for those natural resources is a huge task, and Montana residents and visitors are fortunate that FWP maintains a team of dedicated resource professionals committed to the best possible management and service.

I've been aware of Montana's remarkable people and natural resources for more than three decades, since the late 1970s when I spent summers working on a Montana ranch. I've maintained close friendships with many Montanans, and as a lifelong hunter and angler I have closely watched the issues affecting those activities here and across the West.

After receiving a degree in outdoor recreation from Colorado State University, I worked for the Colorado Division of Parks for 25 years, in positions ranging from park ranger to deputy director. In 2006 I was named administrator of Montana FWP's Parks Division. Since then, I have worked closely with other FWP administrators and staff to learn about issues facing this department.

As acting director, my goal is to build on the department's best traditions and do everything I can to continue its long record of serving Montanans and their fish and wildlife resources. In the months ahead, you can expect FWP to focus on, among other issues:

- Working to delist the grizzly bear and wolf so management reverts to the state.
- Boosting efforts to address the issue of brucellosis transmission to cattle by wild elk and bison.
- Improving public access for hunting, fishing, and other outdoor recreation through Habitat Montana, Block Management, and the Access Montana Initiative.
- Enhancing our system of state parks and fishing access sites, especially in and near Montana's growing urban areas.

One of my top priorities will be to hear what people have to say about FWP, both the complimentary and the critical. I know that this department's decisions affect many groups, organizations, and individuals, and I will take the time to meet with them and learn of their concerns. During my time as the Parks Division administrator, I traveled throughout Montana to better understand the state's people and resources. As FWP's acting director, I will continue that process of listening to and learning from Montanans across the state.

These are times of enormous uncertainty and change—political, economic, social, and climatic. Fortunately, many things in Montana will stay constant. Our trout fishing will continue to be some of the best in the United States, elk populations will stay healthy, Bannack Days will still provide a weekend of family fun, and Lewis and Clark Caverns will still be a place of underground enchantment. Walleye anglers this summer will have another great season on Fort Peck Lake, hunters will continue to enjoy outstanding opportunities this fall, and our wildlife diversity will remain the envy of states across the country.

As I strive to make FWP an even better agency, I also want to acknowledge how fortunate we are to live in a state with such exceptional fish and wildlife populations, hunting and fishing recreation, and state parks.

—Joe Maurier, *Acting Director, Montana FWP*

NATURAL WONDERS

ILLUSTRATION BY PETER GROSSHAUSER

Q. ***I know fish can detect sound and pressure waves, but do any Montana fish actually generate sound waves to any purpose or advantage?***

A. The freshwater drum does. During the spring mating season, males of this close relative to the saltwater redfish vibrate a unique set of muscles and tendons against their balloonlike swim bladder. This produces a grunting sound thought to attract females from a distance. Anglers have reported hearing the strange sounds while fishing the lower Yellowstone and Missouri rivers, where drum are found. In some states, drum are called croakers or thunder-pumpers for the sound.

Q. ***Do birds blink?***

A. Yes, says Kristi Dubois, FWP native species coordinator in Missoula, but not quite the same way humans do. Birds have an extra eyelid, a transparent membrane that lets them blink without closing their eyes. This "nictitating" membrane helps keep a bird's eyes moist without blocking vision during flight. Birds usually close their main eyelids only when asleep.

Lakota warriors charge soldiers at Rosebud Battlefield. From *Frank Leslie's Illustrated Newspaper*, 1876.

ILLUSTRATION BY CHARLES G. STANLEY, AUGUST 12, 1876. DENVER PUBLIC LIBRARY, WESTERN HISTORY COLLECTION

Rosebud Battlefield receives National Historic Landmark designation

Rosebud Battlefield State Park, roughly 90 miles southeast of Billings, preserves the pivotal battleground where, on June 17, 1876, the balance of power between the U.S. Army and the Indians temporarily shifted. The Lakota and Northern Cheyenne warriors' victory that day over Brigadier General George Crook strengthened their resolve and convinced them they could fight soldiers and win—which they did again just eight days later at the Battle of the Little Bighorn.

In October 2008, the site's historical and cultural significance was recognized when the battlefield and surrounding state park were named to the list of National Historic Landmarks. "Since fewer than 2,500 National Historic Landmarks exist in the United States, this designation signifies the historical importance of the site for this country and for the Lakota and Northern Cheyenne people," says Chas Van Genderen, chief of FWP's Parks Division.

One of the many famous heroic acts that occurred on the battlefield was when Buffalo Calf Road Woman rescued her older brother, Chief Comes In Sight. The warrior had been trapped after his horse was shot out beneath him. As the soldiers advanced, Buffalo Calf Road Woman rode through a hail of bullets into the open field. Her brother jumped onto the horse, and together they rode to safety. A description of the rescue was included in the site's nomination documents.

To commemorate the National Historic Landmark designation, the Northern Cheyenne tribe hosted a celebration in Lame Deer on October 25, 2008. At the event, Governor Brian Schweitzer expressed his appreciation for the tribe's efforts to help secure the federal landmark designation and spoke of the need to protect Montana's heritage for future generations.

Rosebud Battlefield State Park today

O. LUNNELL BLANK

New book tells of Montana's great wildlife recovery

Montana is renowned throughout the world for its wildlife. Elk, bighorn sheep, grizzly bears, pronghorn, and other charismatic species define a state that has earned a reputation for healthy populations of wild animals that have disappeared from most of the United States.

That wealth of wildlife is no accident, write the authors of *Montana's Wildlife Legacy—Decimation to Restoration*, an important new book. Populations of elk and other wildlife in Montana have been restored over the past 70 years by conservationists, ranchers, and wildlife professionals dedicated to preserving the state's wildlife legacy.

Written by Harold Picton, professor emeritus of wildlife management at Montana State University, and Terry Lonner, former chief of FWP wildlife research, the richly illustrated 300-page softbound book takes readers on a journey through Montana's wildlife history. It begins before European settlement, moves through the era of market hunting and overexploitation, and continues with a century of restoration. The work of recovering decimated wildlife populations was started by Montana's territorial legislature, President Theodore Roosevelt,

and early sportsman's groups. It then blossomed in the mid-20th century with the hiring of Montana's first trained wildlife biologists. To illuminate that rich history, Picton and Lonner interviewed dozens of retired biologists, wildlife managers, and other pioneers of the 1940s and '50s. These individuals, the authors point out, were responsible for the abundant wildlife Montanans and state visitors enjoy today.

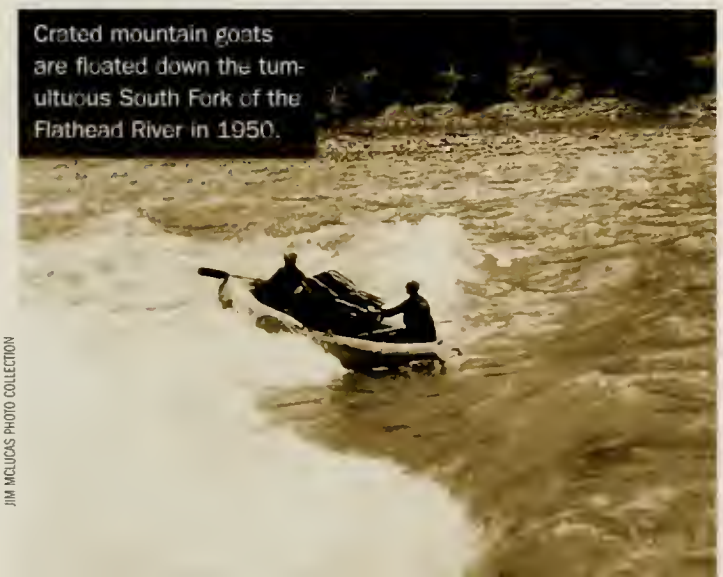
Specific chapters highlight big game species as well as furbearers, wolves, and birds. The authors explain how wildlife workers trapped elk, mountain goats, bighorn sheep, and pronghorn from remaining population strongholds and transplanted the animals to their historical habitats. The book includes the complete compilation of Montana's wildlife trapping and transplanting records, including maps showing where the animals were captured and released. More than 600 other maps, tables, charts, and footnotes lend the book academic authority, while stories and personal accounts enliven each chapter.

One example is the story of how, in 1950, Jim McLucus and other wildlife workers rigged up a mountain goat trap at a salt lick in today's Bob Marshall Wilderness. They floated the captured goats in a rubber raft down the rapid-filled South Fork of the Flathead River to a remote airstrip, where the animals were loaded onto an airplane and flown to a release site.

Crashing in a mountain storm or drowning in the tumultuous river were not the only dangers that wildlife workers faced. "McLucus and a few other individuals were gored by goats, necessitating trips to emergency rooms to repair puncture wounds in their legs," the authors write.

Such colorful tales notwithstanding, the book contains a somber message: As shown in the late 1800s, mismanaged wildlife populations can collapse far more quickly than well-managed ones can be restored. If Montana hopes to preserve its economically and culturally valuable wildlife legacy, the authors warn, it must continue to support scientific ecological research and maintain the financial and political support for wildlife management that comes from public participation in hunting.

Montana's Wildlife Legacy sells for $29.95 and is available at Montana bookstores, at FWP regional offices, and on-line at montanaswildlifelegacy.com.



Crated mountain goats are floated down the tumultuous South Fork of the Flathead River in 1950.

JIM MCLUCAS PHOTO COLLECTION

The Supreme Court justices said Mitchell Slough is a side channel of the Bitterroot River and not an irrigation ditch, as adjacent landowners contended.

BARBARA MICHELMAN

State Supreme Court rules that Mitchell Slough is public water

In a victory for public access advocates, the Montana Supreme Court in November 2008 unanimously ruled that a 16-mile side channel of the Bitterroot River near Stevensville is open to recreation under the state's stream access law. The court's 54-page decision overturned two earlier lower state court decisions that sided with adjacent landowners. The landowners maintained that the waterway was technically an irrigation ditch because they had made significant alterations.

In 2003 the Bitterroot River Protection Association filed a lawsuit in state district court challenging a decision by the local conservation district to classify Mitchell Slough as a ditch. The association asserted that the public should be able to recreate on the waterway. FWP took part in the litigation, arguing that Mitchell Slough was a public access stream.

The Supreme Court affirmed that the claimed ditch was in fact a side channel of the Bitterroot River, despite the alterations, and is subject to stream access and public recreation as provided by Montana's stream access law.

The court also confirmed that the waterway runs through private property. Anglers and others may recreate only under the terms of Montana's stream access law, which allows access on the water and up to the ordinary high-water mark on the stream bank. Landowner permission is required to cross private property.

Bob Lane, FWP's chief legal counsel, says the Mitchell Slough decision has statewide implications. "The Supreme Court's decision means that streams and side channels throughout Montana remain public waters and do not become private property just because people alter or manipulate them," he says.

OPERATION GRIZZLY

A monitoring project of military proportions produces an elusive population number and other critical information on northwestern Montana bears.

BY TOM DICKSON

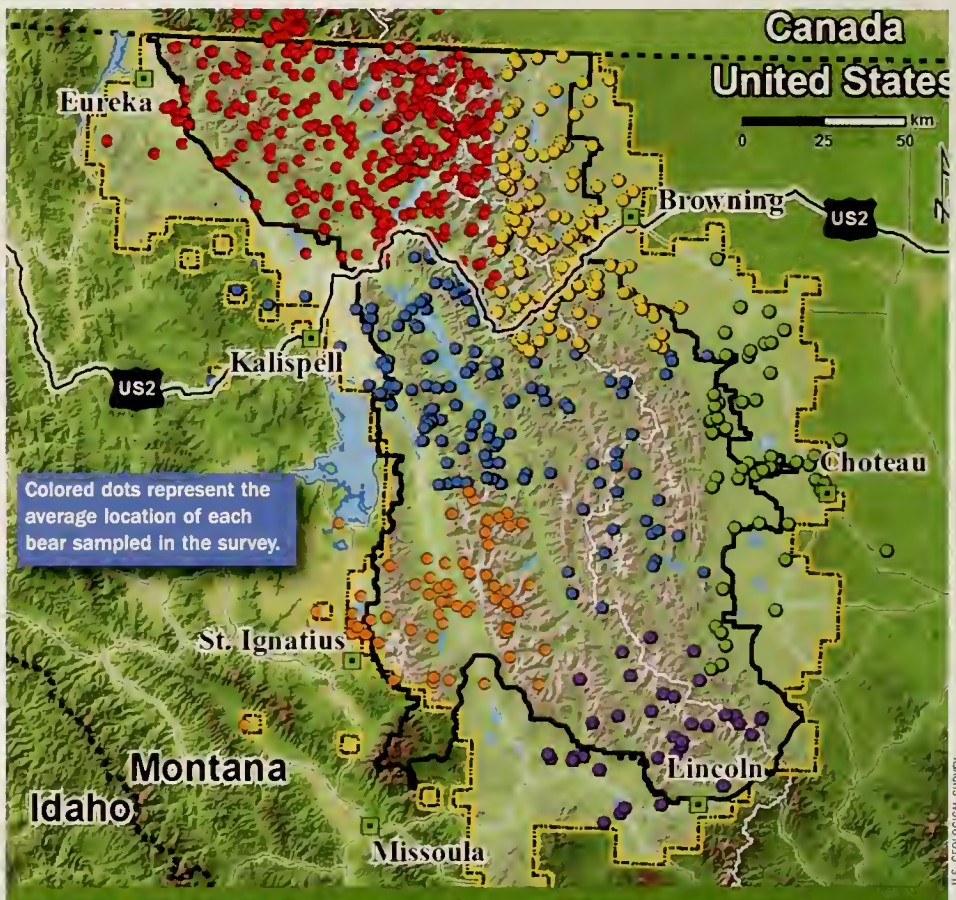
It took five years, hundreds of workers, and 34,000 hair samples, but scientists finally know how many grizzly bears live in the Northern Continental Divide Ecosystem (NCDE). The number—765—was released recently by the U.S. Geological Survey (USGS), which undertook the massive bear monitoring project in cooperation with federal, state, and tribal agencies, private landowners, and universities.

Grizzly bears in the NCDE were listed as threatened in 1975 under the Endangered Species Act. Thirty years later, officials with the U.S. Fish & Wildlife Service (USFWS) needed to know the population size and its upward or downward trend over time to determine if the bear was ready to be considered for delisting.

Grizzlies are notoriously difficult to count, especially in the NCDE. Comprising a roughly 8-million-acre area surrounding Glacier National Park and extending south to the Blackfoot Valley, it is one of the most inaccessible ecosystems in the Lower 48 states. Biologists could not accurately estimate the population using traditional wildlife monitoring methods such as air surveys. Then, in the early 1990s, scientists discovered how to read DNA from bear hair follicles to determine the identity of individual animals. The scientific breakthrough opened the door to a new way of estimating bear populations.

The NCDE is an area the size of Maryland and Delaware combined, located in the heart of the Rockies. Capturing hair samples there required an operation of military proportions. In 2004, more than 400 employees and volunteers drove 300,000 miles and hiked 18,000 miles to identify and check "rub" trees and set up and gather samples from hair trap stations. The 2,558 hair trap stations consisted of small woodpiles soaked in a smelly concoction of fermented blood and fish, surrounded by a single strand of barbed wire. The barbs snagged the hair of bears lured to the sites. Hair was also obtained from 4,795 unscented trees and posts where bears naturally scratch their bodies, as well as from "management" bears trapped by state and federal agencies for research or removal.

After being gathered and sorted, the hair samples were sent to a private genetics laboratory in British Columbia for analysis. A team of top scientists then conducted mod-



GENETIC SEPARATION The grizzly study turned up six genetic subpopulations in the NCDE. Though many bears move among subpopulations, breeding occurs mainly within subpopulations, according to project leader Kate Kendall. Grizzlies in the subpopulation along the Rocky Mountain Front (green dots) are the most genetically distinct. They feed on abundant winterkilled cattle and wildlife and tend to be larger than those in other subpopulations, Kendall says. Another finding was that the western portion of U.S. Highway 2, where human density is higher, is beginning to form a barrier to genetic mixing. "With new houses comes more garbage and other attractants that draw bears, which often leads to lethal removal before the bears can reproduce," says Kendall. "Roads aren't the barrier as much as the associated development."

Tom Dickson is editor of Montana Outdoors.

BIG, YES, BUT GROWING? Scientists now know the Northern Continental Divide Ecosystem grizzly population is more than twice previous estimates. Is it increasing and thus ready for federal delisting? Biologists will need several more years to find out.

eling to come up with the population estimate of 765 grizzlies—more than twice the 300 to 400 number the USFWS had previously estimated, based on sightings of female grizzlies with cubs.

Kate Kendall, a U.S. Geological Survey research biologist stationed at Glacier National Park who orchestrated the operation, says the DNA study provided other important information. It showed that grizzlies occupy a range of 2.6 million acres (yellow line in map at left), considerably beyond the recovery zone boundary set in 1993 by the USFWS (black line). The study also showed that the ecosystem contains six distinct genetic subpopulations. "Overall, the genetic health of the population is good," Kendall says. "The genetic diversity approaches levels seen in undisturbed populations in Canada and Alaska. There's no generic evidence that the population size was ever severely reduced or that its connection to Canadian populations has ever been broken."

Chris Smith, FWP deputy director, says the new grizzly population estimate means that human-caused mortality—due to trains, cars, and lethal removal of problem bears—has not been reducing the NCDE population. "It also gives us more management flexibility, such as being able to transplant some NCDE bears to the Cabinet-Yaak Ecosystem, where we've had trouble establishing a strong population," he says.

The study—the largest ever of a brown bear population—produced what scientists say is a remarkably precise population estimate. Kendall credits the precision to the large sample size, multiple sampling techniques, and state-of-the-art genetic analysis and population modeling. "We wanted to make sure the data and science were rock solid and would hold up under the most intense scientific and legal scrutiny," she says. Complete results of the grizzly bear project are featured in the January 2009 issue of *The Journal of Wildlife Management.*

Despite the project's success, the USFWS is not ready to consider delisting the population. That will take several more years, say state and federal officials. Because the population estimate is for only 2004, biologists still do not know whether grizzly numbers are increasing or decreasing. FWP is tracking radio-collared female grizzlies in the NCDE to monitor their survival and cub production. Scientisrs will use the information to determine a trend for the entire population. "Given the results of our project, if the monitoring program shows an upward population trend, the U.S. Fish & Wildlife Service would likely begin deliberations on delisting the population," says Kendall.

WATCH THE BEARS RUB TREES

For more information on the grizzly bear DNA project, visit: nrmsc.usgs.gov/research/NCDEbeardna.htm. The site includes footage from remote cameras that researchers set up to learn how bears use "rub" trees and hair traps. The fascinating footage shows grizzly bears as well as wolves, deer, elk, wolverines, pine martens, and other wildlife. "In addition to what we learned, it was amusing to see what wildlife does when you're not around," says project leader Kate Kendall.

NRMSC

Grace from a Gloved Hand

Ordinary Montanans with boundless patience and zeal dedicate themselves to an ancient sport once practiced by kings, sheiks, and emperors. BY DAVE CARTY

The truck in front of me had two hunting dogs in back. That was strange in itself—I'd almost never seen another bird hunter in this area—but even more unusual was how the fellow had been hunting. When he stopped and introduced himself, I learned that while I'd been chasing Hungarian partridge and sharp-tailed grouse with my pointing dog and a shotgun, Craig Campbell of Bozeman had been hunting nearby wheat fields that same afternoon with two pointing dogs and his falcon. Campbell was a falconer, the first I'd ever met. >>

QUIET TIME A gyrfalcon rests on a falconer's thick leather glove, or gauntlet. A stiff leather hood, used by falconers worldwide for thousands of years, keeps the bird calm by blocking visual stimulation. The decorative leather knob at the top is for easy removal.

JOAN SMETANA

Campbell and other falconers later introduced me to this remarkable hunting method that has an ancient and royal heritage and is still practiced today by a handful of dedicated Montanans from all walks of life.

Falconry is a sport that predates Montana and the rest of the United States by thousands of years. It was first practiced in Mesopotamia, now Iraq, as early as 2000 BC and later developed in Persia, India, China, Korea, and Japan. The Romans introduced falconry, also known as hawking, throughout Europe and Great Britain, where both royalty and commoners practiced it widely during the Middle Ages. Social class determined raptor ownership: Only kings could fly gyrfalcons, the largest of all falcons; earls and dukes owned peregrines; yeomen used goshawks; and peasants were restricted to kestrels. Among the famous British and European royals who flew falcons were Mary, Queen of Scotts, King Charlemagne, and Holy Roman Emperor Maximilian I. Falconry's popularity began to decline in the 17th century, after the invention of firearms provided a more efficient way to kill game.

In the United States, falconry was rarely practiced until after World War II. Two of the sport's leading early practitioners were wildlife research scientists Frank and John Craighead, who first wrote about it in *National Geographic* in 1939. The North American Falconers' Association was established in 1961, but the use of raptors for hunting did not take off until several years later, when falconers discovered that the ubiquitous red-tailed hawk was trainable. (The term "falconer" includes both true falconers, who hunt only with what are known as "long-wings": peregrines, merlins, and other falcons, and "austringers," who use red-tailed hawks, goshawks, and other bureos and accipiters.) Today roughly 4,000 falconers are licensed in the United States.

Despite its raptor diversity and abundance, Montana has not been a big falconry state. Only about 90 licensed falconers practice the sport here. Falconry has been legal in Montana since 1971, when the legislature passed a law requiring that falconers be licensed by Montana Fish, Wildlife & Parks. A few years later, the state adopted the federal guidelines for registering and keeping the birds, including regulations mandating that raptors wear identifying leg bands and that a falconer's facilities and equipment be inspected before a license is issued. The stringent requirements for owning, hunting, and trapping raptors were established largely at the urging of the practitioners themselves.

This is no sport for dilettantes. Falconry requires extensive training, constant practice, and an almost

Training a Raptor

PHOTOS BY JULIE COWAN/COWAN CREATIVE

ANCIENT TECHNIQUES Falconers still use many training methods and devices unchanged from antiquity. 1. Wild raptors are captured in a bal-chatri, a baited box covered with fishing line snares that capture the bird when it lands to grab the bait. Once trapped, the bird is quickly hooded and secured. 2. After trapping a red-tailed hawk, a falconer carefully inspects the bird and cleans its beak. 3. Lightweight leather jesses are attached to a raptor's legs so it can be tied to a perch. 4. A red-tailed hawk is secured to a training line, called a creance, for an early training session. 5. A stiff leather hood keeps a captive raptor calm by blocking distracting sights. 6. An American kestrel plucks raw meat from a lure used for aerial training. 7. A falconer holds a red-tailed hawk on a heavy glove, called a gauntlet. Small bells connected to the jesses help the falconer hear and interpret the raptor's actions.

KATE DAVIS

FOLLOW THAT FALCON
A peregrine takes flight with tiny radio transmitters and trailing antennae attached to its legs. Falconers use electronic receivers to track their birds from up to several miles away.

fanatical dedication to the birds. "You can't just put them in a barn, throw in some food once in a while, then hunt them," Campbell says. "You have to fly them year-round, and fly them at game during the season. Then you need dogs for pointing the birds, and homing pigeons for training. Falconry is a huge investment." Especially in time. It can take years before someone with a budding interest in the sport can actually own, then hunt with, a bird of prey.

To earn an FWP apprentice license, a prospective falconer must be at least 14 years old, find an experienced falconer willing to be a mentor for two years, and pass a comprehensive written test. Apprentices may fly only kestrels or young red-tailed hawks, which are common and easier to handle than other raptors. After two years, an apprentice may receive a general license and keep two raptors of any species. After five years in the general category, a falconer qualifies as a master and may keep up to three birds. In addition to a state license, all falconers must receive certification from the U.S. Fish & Wildlife Service. "Falconry is not just a sport," says Kate Davis, a master falconer and founder of the Raptors of the Rockies education center in the Bitterroot Valley. "It's more a complete and all-consuming lifestyle that you dedicate yourself to year-round. I basically try to talk people out of it."

A widely used raptor for falconry is the gyrfalcon-peregrine cross, which has the size of the former and the speed of the latter. Also popular are pure-strain peregrines, northern goshawks, red-tailed and Harris's hawks, merlins, and kestrels. Falconers obtain raptors by buying them from a licensed propagator, trapping immature birds, or taking chicks from the nest. Though legal in Montana, chick removal has been controversial, especially for peregrine falcons. The species was federally delisted in 1999 and removed from the Montana list of endangered species in 2005. In 2008 the FWP Commission agreed to requests by many falconers to allow an annual total "take" of three peregrine chicks (less than 5 percent of the known production of young) to be raised and trained for falconry. The ruling was opposed by other falconers who wanted the commission to wait until peregrines had recovered throughout their entire historical habitat in the state.

Hunting with hawks and falcons is a spectator sport in which the raptor does most of the work. When the hunt begins, a falcon is released to circle in the sky hundreds of feet above the falconer, who often uses hunting dogs to locate and flush game birds. Once the falcon spots the quarry, it drops from the sky in a "stoop" at breathtaking speed—up to 200 miles per hour for a peregrine or gyrfalcon. Falcons kill some birds by striking the head or body with open talons. They kill others by flying in a J-pattern and coming up underneath the quarry, grabbing the belly and pulling the bird to the ground before finishing it off with a bite to the spine. When hunting with a hawk, falconers generally carry the bird on their fist, protected from the talons by a thick leather glove, called a gauntlet. To keep the hawk calm, its head is covered by a stiff

leather hood. When a rabbit, squirrel, or game bird is spotted, the hood is removed and the hawk jets after the quarry. Sometimes a hawk is allowed to follow the handler by perching in treetops or on power poles until the quarry is spotted. Harris's hawks often are hunted in pairs from atop a 10-foot-tall, T-shaped perch the handler carries while walking in the field. To locate their raptors from a distance, falconers attach small bells or lightweight radio transmitters to the birds' legs.

After the kill, a trained raptor returns to the handler's glove or perch or stays with the dead prey until it is retrieved. Raptors are generally not allowed to eat their prey other than the head and neck. "When everything goes as planned, the raptor will step off its kill and take the treat—such as a quail leg—and then you can keep the game bird for a meal," says Davis.

Hawks are used to hunt small mammals and birds, both flying and on the ground, while falcons are used only for flying birds. The exception is kestrels, which, topping out at just 5 ounces, are too small for birds larger than sparrows. "A lot of falconers actually fly their kestrels to chase grasshoppers and dragonflies," Campbell says, describing what is known as microhawking.

WENDY RAYNAL

DUCK DINNER Master falconer Kate Davis of Florence holds her prized peregrine, Sibley, and a recently killed mallard.

Falconry is not a sport that puts much meat on the table. According to the Colorado Division of Wildlife, it takes the average falconer more than nine hours of hunting to kill a single game bird. (With a shotgun, by comparison, it's not uncommon to kill a limit of four sharptails before noon.) Part of the sport's appeal is its heritage, which includes terminology, training methods, and certain gear that have remained basically unchanged for thousands of years. But the big attraction, says Davis, is watching raptors in action. "A falcon's stoop is so remarkable that sometimes we cheer when it hits the prey," she says.

So that I could experience falconry firsthand, Campbell allowed me to tag along one morning. The regular firearms bird season had ended, but because the falconry season runs through March 31, he was still hunting with his birds almost daily. We met at his house near Bozeman and loaded his pointers. After driving miles onto the prairie, Campbell pulled over and released a pointer, which raced out into the grasslands. It was not long before the dog went on point. Campbell loosed the falcon on his wrist, and the handsome creature caught a breeze and soared into the sky hundreds of feet above us. As we approached the dog, a covey of Hungarian partridge burst from the short grass, their russet feathers glowing red in the winter sun. Then the birds did something I'd never seen in all my years of Hun hunting: They dove back into the wheat just a few dozen yards ahead. Ordinarily, Huns will fly wildly when flushed, but they had spotted the falcon overhead and refused to remain in flight. One bird, perhaps braver or dumber than the rest, kept flying. Suddenly, with the wind screaming through its pinions, Campbell's falcon dropped from the sky. We watched the Hun dart frantically behind a hill with the falcon just a few feet behind and closing. Neither reemerged. We found the raptor 15 minutes later.

> "Falconry is not just a sport. It's a complete and all-consuming lifestyle. I basically try to talk people out of it."

Davis says locating a falcon after the kill can be difficult, even using a radio receiver. On a recent duck hunt in a swamp with her six-year-old peregrine falcon, Sibley, Davis flushed two mallards. "Sibley hit the second one hard, and I got scared because all I could hear was a *whack*, and I thought she might have hurt herself. I went wading across the slough literally up to my waist, but I couldn't find her. Then I happened to look down a little creek, and there's Sibley, floating along

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Dave Carty is a freelance writer in Bozeman and a longtime contributor to Montana Outdoors.

with both wings and her tail spread out, just her head out of the water. I ran over there, thinking she might have broken her back or something. I took my glove off and reached underwater, and she's got the drake mallard by the head, dead as a doornail. I was so proud, but it took a while to get out of the slough, my legs were shaking so bad."

Davis, author of *Falcons of North America*, can't remember a time when she didn't love raptors. "I started flying kestrels when I was a teenager, and I've never stopped," she says. A fondness for raptors can be bittersweet. The birds are often electrocuted by power lines, injured by flying into wires, or killed by larger raptors such as golden eagles or great-horned owls. Sometimes, after months of training, a captive bird may simply fly off, as once happened with a beloved Harris's hawk Davis owned. "One day I was flying her in my backyard, and she just took off and disappeared. I couldn't believe it," she says. Having previously lost a peregrine, Davis expected the worst. But perhaps certain birds form an attachment to their owners, because four months later the hawk reappeared, flying circles around Davis's house. "I was so thrilled," she says. "She was real skinny, so I guess she eventually got hungry and figured, 'I'd better go home now."

Many websites are filled with information and video clips of falconry techniques and equipment. Among the most comprehensive is themodernapprentice.com.

Falconry Gear

SCALE A traditional balance scale is used to ensure a raptor is at its ideal "flying weight," which varies with the bird's age and experience.

GLOVE Most falconers carry the birds on their hand, protected by a buckskin glove. For large birds, a falconer needs to wear a gauntlet, made of three or four thick leather layers.

TRANSMITTER AND RECEIVER Falconers fit their birds with light radio transmitters they can track from up to several miles away with handheld receivers.

HAWKING BAG Falconers use a lightweight, compartmentalized bag to carry equipment.

CREANCE During early training sessions, the bird is flown on this light tether line before eventually being allowed to fly free.

LURE Meant to resemble a quarry, this scented dummy is attached to a long line and swung around the falconer's head to attract the raptor.

JESSES These short leather straps are knotted loosely around the bird's feet so it may be safely tied to a perch.

SWIVELS These prevent the jesses from becoming tangled.

BELLS Attached to the jesses, bells help a falconer find a lost bird or track one moving its feet on the ground.

HOODS These trick a bird into thinking it is night so it remains still (the origin of the term "hoodwink"). Hoods prevent a bird from harming itself by becoming agitated by too much visual stimulation.

PROUD PEREGRINE A falcon spreads both wings to hide its kill. A well-trained raptor will relinquish its quarry and take a treat, leaving the game bird for the falconer.

FEELING THE HEAT

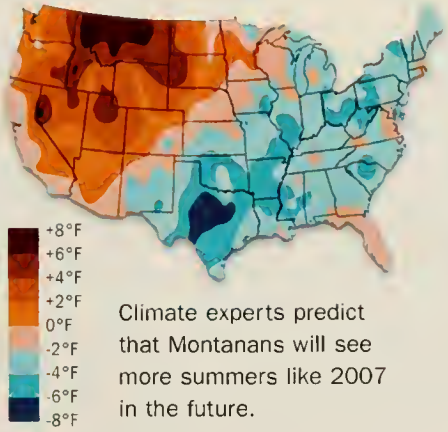
CLIMATE CHANGE IS ALTERING MONTANA'S WILDLIFE AND

One of the great joys of midsummer trout fishing in Montana is standing waist-deep in a cool river as a refreshing breeze wafts off the water. Unfortunately, such pleasures are disappearing as the state's famous blue-ribbon rivers simmer under some of the hottest summers on record.

Trout anglers thought things were bad enough in 2001 and 2006, when thermometers registered unprecedented summer highs across much of Montana. But 2007 was worse. In July both Helena and Billings recorded eight days above 100 degrees. On July 6, when Missoula's afternoon temperature usually tops out at about 83, the city set a record of 107, the first of an unprecedented 11 days above 100.

The same blistering heat was baking nearby trout rivers. Yellowstone National Park's Firehole River, just a few miles from the Montana border, was closed after it hit 82 degrees, killing hundreds of trout. The Big Hole River upstream from Wisdom reached nearly 80 degrees and dwindled to a trickle of just 13 cubic feet per second. Water temperatures on the Yellowstone, Blackfoot, Beaverhead, Big Hole, and other blue-ribbon rivers topped 73 degrees for three consecutive days, triggering mandatory stream closures to protect trout from the added stress of being caught and released. By summer's end, Montana Fish, Wildlife & Parks had been forced to close or tightly restrict fishing on a record 29 rivers. As the heat wave drove thousands of disappointed anglers indoors, it scorched the fishing industry's bottom line. "August that year was just dead for us on the Missouri," says Chris Strainer, owner of the Cross Currents fly shops in Helena and Craig. "I'd look out the window on a Saturday afternoon and not see a single boat on the water."

July 2007 Temperature Departure
from the 1971–2000 normal average SOURCE: NOAA



Climate experts predict that Montanans will see more summers like 2007 in the future.

Hotter, longer summers and shorter, warmer winters have become the norm in Montana over the past decade. The cause, say climate scientists, is a changing global climate. As temperatures continue to increase, Montanans will see even greater alterations in precipitation, drought duration, snowpack levels and runoff, and the timing of plant and animal cycles. Already the warming has delayed waterfowl migrations, shortened ice-fishing seasons, and made elk hunting tougher by allowing the animals to stay high in the timber throughout the season. "Hunters and anglers are often the first people in Montana to witness the effects of climate change," says Bill Geer, Climate Change Initiative manager with the Theodore Roosevelt Conservation Partnership. "Climate change isn't some abstract theory to a trout angler who can't fish the Beaverhead because it's closed, or an elk hunter who waits all fall for elk that never come down. It's a reality we've been dealing with for years."

And there's no relief in sight. In the not-too-distant future, Montanans could see smallmouth bass replacing trout in some

FISH POPULATIONS, HABITATS, AND RECREATION

BY TOM DICKSON

CASTING FOR SMALLIES? "It's clear that the future implications of climate change in Montana are fewer trout and fewer opportunities to fish for trout," says Bruce Farling, executive director of Montana Trout Unlimited. Farling notes that hotter temperatures over the past decade have often shut down Montana's most popular trout streams during the height of the fishing season. FWP officials say portions of some blue-ribbon rivers could soon become better suited to smallmouth bass.

GRINNELL GLACIER, 1938–2006

MELTED ICE NATIONAL PARK As seen from the summit of Glacier National Park's Mount Gould, Grinnell Glacier has shrunk over the past several decades while Upper Grinnell Lake has grown from the melted ice. Scientists estimate that by 2025 warming temperatures will have melted all the park's glaciers. The heat could also force pikas and other alpine wildlife to smaller areas at higher elevations.

rivers, fewer mountain goats and other alpine species, earlier and more widespread summer stream closures, and millions more acres of dead and dying beetle-infested forests (see sidebar, page 20). Concerned about these and other warming-caused scenarios, FWP officials have begun studying how a changing climate might help or hurt fish and wildlife and figuring out ways to revise management activities in response. "We certainly can't stop climate change," says Ken McDonald, FWP Wildlife Division chief, "but we know it's coming, and we have a responsibility to prepare for the impacts on Montana's wildlife."

HOT SKY COUNTRY

People may argue over how much of climate change is manmade, but there's no disputing that the planet is warming. The latest report from the Intergovernmental Panel on Climate Change (IPCC) says temperatures have increased an average of 1.5 degrees F worldwide over the past century and are expected to climb another 4 to 12 degrees, depending on carbon dioxide levels, by 2100. According to Dr. Steven Running, an ecology professor and climate expert at the University of Montana, the average annual temperature in Montana has increased 2 degrees over the past 50 years, even more than the global average. "There's no doubt in my mind that global warming is real and that the impacts to Montana will accelerate," says Running, a lead author of the IPCC's most recent report.

Climate has been in flux throughout history, Running says, but temperatures since the late 1800s, and especially during the past three decades, are higher than at any time in at least the past 13,000 years. The warming is the result of what's known as the greenhouse effect, caused when carbon dioxide—produced by the burning of oil, coal, or gas—traps heat within the earth's atmosphere. Even with new efforts to cut down on emissions, Running says, global oceans during the past 50 years have absorbed so much additional heat—which will be released later—that continued warming is inevitable. He and other climate experts predict that Montana's average temperatures will rise another 3 degrees by 2050.

One of the most noticeable and significant effects will be a thinner and faster-melting mountain snowpack. Snowpack keeps valley rivers cool and flowing as it slowly melts in summer. Though total snowfall in western Montana will likely remain the same, says Running, "warmer late-winter temperatures will mean the snowpack won't stay on the mountains and politely melt in June and July when we need it." That's trouble for trout. Without adequate snowpack, river water can warm to the point where the fish die of heat stress or levels drop so low they become stranded. Monitoring stations in Billings and Kalispell show that average March air temperatures are up 6.2 degrees and 7.8 degrees,

> "Warmer late-winter temperatures will mean the snowpack won't stay on the mountains and politely melt in June and July when we need it."

"We're particularly concerned about the black swift, which is an uncommon species that nests behind glacier-fed waterfalls."

respectively, from what they were 50 years ago. April 1 snowpack in western Montana has declined 30 to 40 percent and peak river runoff arrives on average ten days earlier. "In a few decades, Montana's climate could look a lot more like what Utah now has," Running says.

BAD FOR BULL TROUT AND GRAYLING

"Global warming is the single greatest threat to the survival of trout in America's interior West," concludes a recent report jointly published by the Natural Resources Defense Council and Montana Trout Unlimited. To make matters worse, the trout and other salmonids most vulnerable to warming are already in trouble. Numbers of arctic grayling in the Big Hole River dropped from an average of 60 per mile in the 1990s to roughly 10 in 2006. And rising temperatures could drastically shrink the range of bull trout, which need extremely cold water for spawning and rearing, says Dr. Bruce Rieman, research scientist emeritus with the U.S. Forest Service's Rocky Mountain Research Station in Missoula. Other possible losses in Montana include shrinking wetlands, smaller cutthroat populations, withering sagebrush ecosystems, and fewer high-elevation birds (see sidebar, pages 18–19). Montana also stands to lose most of its whitebark pines, which produce seeds eaten by grizzly bears, Clark's nutcrackers, and other wildlife. A critical subalpine ecosystem species, whitebark pines are being "devastated" by heat-loving mountain pine beetles, says Diane Six, a University of Montana professor of entomology.

A warmer, drier Montana would not threaten all wildlife. Adaptable species such as Canada geese and white-tailed deer would likely thrive. Woodpeckers, bluebirds, and other cavity-nesting birds would benefit from the snags created by beetle infestations and wildfires. There would be fewer March blizzards, which often kill winter-weakened elk, mule deer, and pronghorn. And wild turkeys and other species restricted by Montana's frigid temperatures would prosper from milder winters.

CLOCKWISE FROM TOP LEFT: ISTOCKPHOTO; JAIME AND LISA JOHNSON; MACNEIL LYONS; JESSE VARNADO

WINNERS AND LOSERS Woodpeckers would thrive in a warmer Montana, at least temporarily, in forests killed by beetles and fire. Elk numbers would grow due to expanded foothill grasslands and fewer March blizzards. But alpine species such as pikas could disappear, and Yellowstone cutthroat trout would be restricted to colder headwater streams, disappearing from the Yellowstone River entirely.

"The idea would be to focus attention on species with the best chances of survival and...reconsider the effort we spend on species we probably can't save."

Some fish species also would thrive as Montana streams and rivers warm up. Brown trout already are appearing farther upstream on the Yellowstone River than ever before. Less turbidity from fewer summer thunderstorms has benefited the nonnative smallmouth bass, a sight-feeding fish spreading west in the Yellowstone from Miles City to Billings.

"We know that changes in fish populations will continue to occur, but no one really knows what the tipping point is for natural aquatic systems and how well they can adapt to change," says Chris Hunter, chief of the FWP Fisheries Division.

Tom Dickson is editor of Montana Outdoors.

HABITAT-BASED RESPONSE

FWP officials say the best response to climate change is to redouble efforts to protect and restore vital habitat. "What's essential is to maintain water in streams, no matter how warm it gets," says Hunter. One successful example has been to obtain water from landowners through leases, donations, and cooperative agreements that maintain the minimum river flows fish need to survive. "We also have to restore and protect more streamside vegetation that shades and cools water," Hunter says. FWP fisheries biologists aim to replicate successful landscape-scale conservation work already underway in several watersheds. On the Blackfoot River, for example, landowners, trout anglers, and other conservationists have restored 80 miles of river and tributaries and protected 95,000 acres of private land with perpetual conservation easements. On the Big Hole, state and federal agencies have worked out an agreement with ranchers, who agree not to draw water from the river and its tributaries for irrigation when late-summer flows decline to dangerously low levels. Other projects that help Montana trout survive: reconnecting stream stretches blocked by culverts and dams, reducing siltation from old logging roads, and building watering tanks so cattle can be fenced away from stream banks.

Wildlife officials advocate a similar multipronged, habitat-based approach. "Our goal is to protect and restore ecosystems to make

POSSIBLE FISH AND WILDLIFE LOSSES AS CLIMATE CHANGE CONTINUES:

FEWER DUCKS AND OTHER WETLAND SPECIES

Federal waterfowl managers say warming temperatures could dry up wetlands in North America's Prairie Pothole Region (including portions of northeastern Montana), halving waterfowl populations by the end of this century. "Several large public wetlands in central Montana have been dry for going on nine years now," says Jim Hansen, FWP wetland wildlife coordinator. "The lack of winter runoff and heavy spring rains might be reducing duck production in that region, not to mention waterfowl hunting opportunities."

MONTANA FWP

FEWER YELLOWSTONE CUTTHROAT TROUT

"The Yellowstone cutthroat trout would eventually be restricted to the cooler headwater streams," says Chris Hunter, chief of the FWP Fisheries Division. "We won't find them in the big rivers like the Yellowstone anymore."

DEPRESSED SAUGER POPULATIONS

"Sauger need the turbid water that comes from runoff, and we expect to see less of that in the future," says Matt Jaeger, FWP Yellowstone River fisheries biologist at Glendive.

INCREASED WILDFIRE

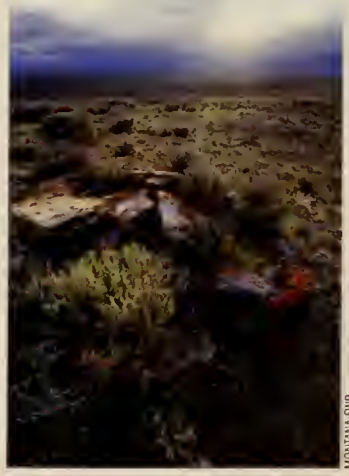
The combination of unlogged century-old stands, earlier snowmelt, longer and drier summers, and increased beetle infestations (see sidebar, page 20) would increase the intensity and duration of Montana wildfires. The U.S. Forest Service predicts

USFS

that if average summer temperatures warm by just 1.6 degrees over the next century, wildfire acreage in the West would at least double. Periodic wildfires are essential for recycling nutrients in forest ecosystems. But intensely hot fires can sterilize soil and cause silt and ash to wash into trout streams during subsequent rains.

SHRINKING SAGEBRUSH-STEPPE ECOSYSTEMS

The U.S. Forest Service estimates that each 1.8 degree temperature increase would cause the loss of 12 percent of the West's current sagebrush habitat, essential for sage-grouse and important for mule deer, pronghorn, and other wildlife. Plant ecologists say a major reason for the loss is that cheatgrass—an invasive species that thrives in hot, open, fire-prone environments—will crowd out native sagebrush.



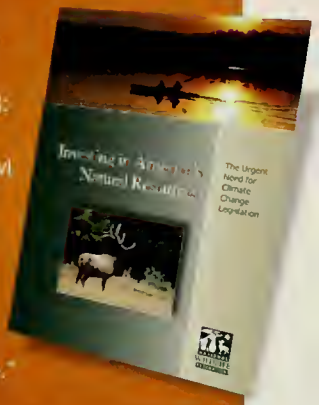
MONTANA FWP

them more resilient to the effects of climate change," says McDonald. Identifying critical habitats and protecting them by purchasing conservation easements and wildlife management areas will be key. Especially important will be riparian habitats—what McDonald calls "ecological arteries for the entire landscape"—such as the Marias and Yellowstone wildlife management areas acquired in 2008. Conservation agencies and organizations will also need to maintain connections between critical habitats so wildlife such as wolverines and lynx can move across the landscape as they seek cooler temperatures.

Those efforts may still fall short for particularly vulnerable species. At a recent climate change workshop sponsored by FWP, the National Wildlife Federation, and other conservation organizations, Dr. Molly Cross of the Bozeman-based Wildlife Conservarion Society predicted that "species unable to

Hunting, fishing, and conservation groups nationwide take climate change seriously

- In 2008, more than 670 conservation clubs from all 50 states, including Montana, took out a full-page ad in *USA Today* expressing their concerns about how climate change is affecting fish and wildlife populations.
- Trout Unlimited, Pheasants Forever, the National Wildlife Federation, and the Theodore Roosevelt Conservation Partnership have made climate change among their top policy issues.
- In spring 2008, the Bipartisan Policy Center and the Wildlife Management Institute jointly published a report on climate change and its effects on outdoors recreation. "Season's End: Global Warming's Threat to Hunting and Fishing," prepares readers for changes such as dwindling Great Plains waterfowl and expanding white-tailed deer populations. The future for hunting and fishing is definitely not all bad, the report concludes, but it will be substantially different from today.
- Montana Audubon has recently released a report on how climate change has affected bird movement over the past 40 years. Visit mtaudubon.org and click on "Birds and Climate."



KERRY NICKOU

FEWER MOOSE

Moose need cool, wet habitat. Though Montana's population appears stable so far, another northern moose state, Minnesota, has seen its population decline by 35 percent since the 1980s. The main cause appears to be heat stress from warmer winters and springs.

FEWER BREEDING BIRDS

In addition to shorebirds and wetland species, warming would put the white-tailed ptarmigan, gray jay, and other high-elevation birds at risk. "We're particularly concerned about the black swift, which is an uncommon species that nests behind glacier-fed waterfalls," says Amy Cilimburg, director of bird conservation for Montana Audubon.

DECLINING WOLVERINE POPULATIONS AND RANGE

Because wolverines need deep mountain snow for denning, warming temperatures could reduce the species' range in Montana. "In the Sawtooths, for example, every den is above 5,000 feet," says Dr. Kevin McKelvey, of the Rocky Mountain Research Station in Missoula. "A mother will actually move her litter uphill if the snow begins to melt, even if the young aren't ready to emerge."

DELAYED BEAR HIBERNATION

Warmer fall temperatures are delaying grizzly bear hibernation. Many bears now stay out during the big game season, increasing incidents of hunters surprising grizzlies feeding on downed elk and deer. "Delayed denning has become a factor we now have to consider when addressing conflicts between humans and grizzlies," says Ken McDonald, chief of the FWP Wildlife Division.

TOM ULRICH

OTHER POTENTIAL PROBLEMS

- loss of brushy habitat in eastern Montana draws due to heat and drought;
- declines in toad and frog populations; and
- fewer snowshoe hares, mountain goats, and pikas as alpine areas shrink.

FROM EVERGREEN TO EVERRUST

In recent years, western Montana forests have been hit by a massive infestation of mountain pine and Douglas fir beetles, transforming them from a sea of green into a sea of rust red. More than 1 million acres of forestland across western Montana has been killed by tiny beetles that have thrived in the state's warming climate. Millions more acres are at risk, according to the U.S. Forest Service.

One of the hardest-hit areas is the 1-million-acre Helena National Forest. Amanda Milburn, the forest's silviculturist, says infestations have exploded from 19,000 acres in 2004 to 350,000 in 2008, an 18-fold increase. In portions of the Bitterroot National Forest, nearly every conifer has been killed by beetles. And vast tracts of the Beaverhead-Deerlodge National Forest have turned gray as needles fall to the forest floor, leaving only bare trunks and branches.

The native insects, of the genus *Dendroctonus* (Latin for "tree killers"), bore through a tree's outer bark and lay their eggs. The larvae eat the sweet layer of inner bark a tree needs to transport water and nutrients from the soil to the branches. Healthy trees fight back by producing a resin that drowns the insects. But old and drought-weakened trees cannot produce enough resin to fight off the invaders.

BUGWOOD.ORG

> "We're seeing 700-year-old whitebark pines being killed off by this epidemic. It's tragic."

Forest ecologists say the beetle epidemic has several causes. Decades of fire suppression has produced forests of similarly aged lodgepole pine. Many trees are now a century old, near the end of their natural lifespan. Recent intense heat and drought further weaken trees. And mild winters allow beetles to thrive during colder months when large numbers historically have died.

Beetle infestations are natural to forests. Dying trees provide habitat for woodpeckers, bluebirds, and other tree-cavity dwellers before falling to the forest floor and decomposing into soil. But recent infestations—when added to dryer summer temperatures—have greatly increased the risk of intense wildfires. Another concern: The beetles are spreading to higher elevations. Scientists are particularly worried about the loss of whitebark pine. The thick-trunked trees produce cones heavy with high-caloric seeds that grizzly bears need to build fat in late summer. Dr. Diane Six, a professor of entomology at the University of Montana, says scientists previously thought whitebark pines grew at elevations too high and chilly for beetle infestations. "We're now seeing 700-year-old whitebarks being killed off by this epidemic. It's tragic," she says.

Though the beetle infestation is too vast to be treated with insecticide spraying, thinning stands can help reduce the beetles' spread. The dead trees can be salvaged for lumber, though the boards have a blue stain from a fungus the insects inject into trees. According to Milburn, the beetles eventually will run out of live trees and die from lack of food. "Other than that, the only thing that will knock them back is several weeks of extremely cold temperatures in midwinter or sustained late-spring frosts," she says.

KENTON ROWE

> "Our focus continues to be to protect and restore critical habitats so that landscapes and wildlife can, to the extent possible, withstand climate change."

adapt or migrate will be in big trouble." She said that if adjusting management activities does not work, conservation agencies and organizations may need to consider triage. "The idea would be to focus attention on species with the best chances of survival and, hard as it might be, reconsider the efforts we spend on species we probably can't save because the warming will make it useless to try."

To learn which species will likely fare best and worst under warmer Montana skies will require more research and population monitoring. The Association for Fish and Wildlife Agencies recommends that Montana and other states boost efforts to identify and assess likely effects of future warming on populations and habitats.

Where would new money for accelerated habitat conservation and research come from? According to Tom France, director of the National Wildlife Federation's Northern Rockies office at Missoula, one option is to use revenue generated by the so-called cap-and-trade system, proposed to encourage industries to reduce carbon dioxide emissions. Under a provision of the Climate Security Act added by Montana's Senator Max Baucus, states would share in roughly $9 billion of additional funding. Though the proposal had widespread bipartisan congressional support last year, "with the current economic climate, it's hard to predict if the fish and wildlife component will survive," France says.

New funding sources will be essential if Montana wants its fish and wildlife management programs to adapt to changing climate conditions. No matter how budget scenarios play out, however, FWP officials say they will continue to focus on making the state's most important land and water habitats as resilient as possible. "Montana's fish and wildlife are also feeling impacts from many other sources, such as invasive species and growing transportation and energy development," says McDonald. "Our focus continues to be to protect and restore critical habitats so that landscapes and wildlife can, to the extent possible, withstand climate change—or whatever other stresses they face in the future."

Learn more

For additional information on the effects of climate change on fish and wildlife and hunting, fishing, and wildlife watching in Montana and elsewhere in the United States, visit:

- Targetglobalwarming.org (sponsored by the National Wildlife Federation)
- Seasonsend.org (sponsored by the Bipartisan Policy Center).

To read the report "Trout in Trouble: The Impacts of Global Warming on Trout in the Interior West," produced by the Natural Resources Defense Council and Montana Trout Unlimited, visit: MontanaTU.org

A grim forecast for Montana's famous trout waters.

DON'T TOSS OUT THE LONG JOHNS

"Every time it gets cold, someone comes up to me in the grocery store and says, 'See Steve? What's all this about global warming?" says Dr. Steven Running, an ecology professor and climate expert at the University of Montana. But Running points out that frigid days, weeks, and even winters will still occur, just not as frequently. This past December, for example, temperatures never rose above zero for an entire week in much of western Montana.

"What we're talking about is climate, which is the decades- and centuries-long trend of weather conditions, not the daily weather people see out their back window," Running explains. "When we say the climate will be trending warmer, we know we'll still have cold years, but we'll have fewer of them, and the cold generally won't last as long as it did in the past."

Another common misconception is that increased snowfall disproves predictions of warming. "In fact, warmer winters in Montana generally have more snowfall, not less," Running says. "In warm winters, we get the moist Pacific air that produces heavy snows. It's the brutally cold winters, where we get that dry Arctic air mass coming down from Canada, when we have the least amount of snow."

PLENTY OF COLD AHEAD Frigid weather will not disappear entirely from Montana, but it will be less frequent and severe.

DENVERBRYAN.COM

PILEATED WOODPECKERS IN FEBRUARY

ESSAY BY RICK BASS

More sounds, on the 18th and 19th of February, after so much silence: the air aswirl with the strange raucous chitterings of the pileated woodpeckers calling out as they fly from ailing tree to ailing tree, searching for the ants and beetles that feast upon those trees, as the pileateds, with their long anvil bills, feed upon those insects, so that—again, another marvelous equation—a forest grove of dead or dying trees, rotting or burned, equals the sight and sound of a great pileated woodpecker, 3 feet from bright red head to tail and with an even larger wingspan, flying through these forests with wild whoops and wails and laughs. And while it is an equation beyond our ken to completely measure or replicate or even fully understand, it is not one that lies beyond our ability to observe and celebrate, which is, to paraphrase the poet Mary Oliver, exactly what I have been doing, all day.

And again, the sameness or similarity of the world's secret equations, and its patterns, expresses itself across the different media; as the shouting, laughing giant woodpecker is in many ways but a miraculous blossoming of the deadstanding spars—little more than a leap of thought, as if the deadstanding spar had all along desired to become such a bright and flightworthy and attractive bird—so too does the sound of the great pileated woodpecker carry within it the same energy and pattern, the vibrancy, of the silent sap that is beginning to stir in the living trees, and of the overwintering insects that are beginning to stir in the dead or compromised ones. It all seems to be attempting to merge, once winter starts to lift.

Unerringly, it seems, the woodpeckers swoop to the trees that contain the stirring insects. (How do they know? By sight, by sound, by odor, by intuition?) Tentatively at first, they begin to tap at the chosen tree, probing it, until, within the first few trial excavations, the tender and delicious insects are revealed to the uncurling tongue, and further excavation begins now in earnest. A rapid, concussive drumming issues throughout the forest, the pileated hammering out its deep and distinctive rectangle-shaped cavity, chips and slivers of bark flying everywhere—the bird, it seems to me, preferring to test the green bark of still-living trees, in February. (Do the woodpeckers mark with anticipation, visually or otherwise, those trees each autumn that are or might possibly be newly diseased?) There could be ten thousand reasons, ten thousand related connections, dependencies and advantages for such an intricate seasonal preference, some acute and exquisite forest balance, but all I know is that in February, one notices with far greater frequency the new-peeled slivers of green glistening bark resting atop the new snow, new wood pale and bright as new-milled lumber, and chips scattered about wildly, looking at first like the residue from where some sawyer passed just hours before with ax or chainsaw. . . .

And in the drumming sound of those excavations, despite the falling snow, one can hear another of the first sounds of spring returning, and in those glistening chips and slivers that the woodpecker has carved from the trunk, one can see that the sap is beginning to move, just like the river, and just like earth, and just like the braids and ribbons of ducks and geese overhead. The butter-colored wood chips are sticky with living resin, and revealed like that, resting upon the open snow, it is as if the blood-within-the-blood, the sap within the sleeping tree, and the sleeping tree within the sleeping forest, is beginning to awaken; and again, whether the woodpecker is drawn to the first few signs and clues of that awakening, or perhaps participates more actively, helping to accelerate that awakening, not just with the booming cannonade of its drumming, and its wild and strange calls, but with the actual cracking open of those new-stirring trees, I could not say for sure, nor have I met anyone who could; nor do I need to know.

Again, I really need only to know that I like to walk across the diminishing snow, in February, usually on snowshoes, and notice, and celebrate, those bright new-peeled ribbons of bark resting fragrant upon the snow, and to know that there are forests where I can do this; that there are forests where I will always be able to do this.

Rick Bass is a novelist and nonfiction writer in Troy. This essay is from The Wild Marsh, *published by Houghton Mifflin Harcourt and scheduled for release in July.*

MICHAEL WOLF

DIGGING DE

At Montana's historical state parks, archaeologists are unearthing clues to how settlers, prospectors, and early American Indians once lived.

BY LEE LAMB

EP INTO HISTORY

Unearthing the buried city of Pompeii or discovering ancient Assyrian treasures may be what archaeologists dream about. But most of their work resembles what John Fielding is doing this summer day: sifting through an old garbage dump. Under an already scorching midmorning sun, Fielding crouches low inside a 1-meter-square pit at the base of the Meade Hotel in Bannack, Montana's legendary ghost town. He slowly and meticulously removes half-inch layers of dirt from the pit and sifts the soil through screens. Fielding works for Western Cultural, a Missoula-based "cultural resource services" firm that Montana Fish, Wildlife & Parks has contracted to explore the outside perimeter of several buildings at Bannack—Montana's first town and territorial capital—that are scheduled for structural renovation. Today he is excavating below an old hotel kitchen window where trash was commonly tossed in the late 1800s. Most of the remains are rocks, broken glass, and pieces of brick, but occasionally the screens trap an artifact, such as an animal bone, dish shard, and what appears to be a bullet casing. "My guess is that it's from a handgun," Fielding says, "but we won't know for sure until we can identify it back at the lab."

For decades, FWP has conducted excavations at Bannack, Fort Owen, Pictograph Cave, Madison Buffalo Jump, and other historically significant state parks to find, document, and

BURIED TREASURES Archaeologists have unearthed pottery shards, jewelry, arrow points, tools, and bones at Pictograph Cave and other state parks. Shown here are artifact replicas on display at the Montana Historical Society.

protect artifacts as required by state law. In 2007, the department stepped up its archaeological activity by creating a Heritage Resources Program. The program's goal is to improve FWP's ability to find and document cultural artifacts at state parks and enhance agency and public understanding of cultural preservation. The program also aims to ensure that historical resources unearthed from state parks are properly managed and interpreted for the public's interest and enjoyment. "Creating a program like this for state parks just made sense," says Joe Maurier, FWP acting director and previously chief of the department's Parks Division. "We have 22 state parks with high historical or cultural importance and eight National Historic Landmarks within our park system. We needed a professional cultural preservation program like those at other Montana historic sites and in other states' park systems."

NOTHING FANCY Archaeologists excavate a site at Fort Owen State Park using ordinary household tools such as brushes, trowels, shovels, yardsticks, and screens. Among the items discovered was an old farming implement (right), perhaps used to dig potatoes.

MONTANA FWP

REQUIRED BY LAW

The Montana Antiquities Act, enforced by the State Historic Preservation Office, requires state agencies to consider how proposed projects would affect prehistoric and historic sites on state-owned lands. In the past, FWP complied with the law by contracting archaeological site testing and survey work when it built a new latrine, installed a parking lot, or made other improvements to state parks. Though the survey results were recorded at the State Historic Preservation Office, the information was scattered. "FWP didn't have an efficient way to see which areas had already been surveyed and what archaeologists had found," says Sara Scott, who coordinates the FWP Heritage Resources Program. "Another concern was that other significant prehistoric and historic sites existed in state parks, but because the areas hadn't been checked out, we didn't know what we had and whether those resources needed protection."

To locate resources potentially needing protection, Scott hired an intern to gather information from the State Historic Preservation Office. The intern created a computer database of maps showing the locations of previously surveyed areas in each park and the exact boundaries of historic or archaeological sites. The database showed more than 200 heritage sites in Montana's 52 state parks. With this information, Scott can determine if a location for a proposed state park improvement project has already been surveyed and what was found.

At Fort Owen State Park, for example, University of Montana students had conducted field excavations beginning in the 1950s. They eventually collected 50 large boxes of artifacts from Montana's first permanent white settlement. Because the artifacts were owned by FWP, the university could not work on them and kept the boxes

Lee Lamb is a freelance writer in Coeur d'Alene, Idaho.

Springfield Model 1873 similar to those used on the Rosebud Battlefield (now a state park)

Poker chips from Bannack State Park

Glass egg from Fort Owen State Park

Deer tooth between 200 and 500 years old, from Madison Buffalo Jump State Park

Fragment of a meerschaum pipe possibly once owned by John Owen, found at Fort Owen State Park

LEFT TO RIGHT: MONTANA HISTORICAL SOCIETY; JODY DURAN; MONTANA FWP; MONTANA FWP; MONTANA FWP

MONTANA FWP

says. "But the artifacts indicate a higher class of living in that isolated settlement."

SURVEY BEFORE DIGGING

Testing sites of proposed development is important, whether artifacts are found or not. Recently archaeologists excavating an area at Fort Owen slated for a new latrine found a fragment from a pipe bowl. The bowl may have been the one founder John Owen lost and wrote about in his mid-19th-century journals. At Pictograph Cave State Park near Billings—once visited by generations of Indians who left paintings on the cave's rock walls—FWP hired archaeologists to excavate an area where the agency plans to build a new visitor center. The findings were insubstantial: just a few chipped stone flakes and animal bone fragments. That was good news, however, because it meant FWP could proceed with its building plans. At another Pictograph Cave site, where a new hiking trail was planned, surveyors discovered an 850-year-old bison bone—a finding that required minor changes to the project.

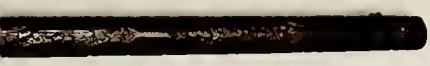
FWP recently hired Aaberg Cultural Resource Consulting Service of Billings to survey First Peoples Buffalo Jump State Park and 400 newly acquired acres to the park. The archaeologists have found previously undiscovered rock cairns, repee rings, and pictographs hidden among the tall grasses and rocks. "Having information like that from the get-go is the ideal way to operate," says Scott. "That way we can work it into our management plans and know where the best places are to lay down campgrounds and trails, rather than just waiting until after a project is planned and then have to adjust construction plans to reduce damage to archaeological and hisroric sites."

"History is typically written about great events and great people, but what we learn from the artifacts we excavate is about ordinary people in their everyday lives."

in its Anthropology Department basement. Recently, FWP and the university signed an agreement that allows the university to record and analyze the artifacts and create a permanent collection.

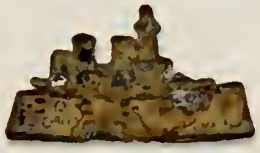
Graduate student Don Merritt is now sorting, identifying, and recording the more than 10,000 artifacts. Most are pedestrian items such as tin food containers, but Merritt has also discovered a rare glass egg—placed in nests to entice chickens to lay real eggs—as well as champagne bottles, elegant candy dishes, and fragments from crystal drinking glasses. "Keeping in mind that Fort Owen was founded on the frontier in 1850, you would think its inhabitants would lack luxury items," Merritt

In addition to survey work, FWP is improving heritage resource management by training existing sraff. Scott is developing policies on caring for artifacts in srare park visitor centers, standards for site surveys and testing, and instructions on Montana Antiquities Act compliance. Recently she provided park managers with maps of their parks showing where previous survey work was done and locations of known historic and archaeological sites. "Park managers have always been responsible for cultural resource managemenr, but our goal is to have them include it in their working vocabulary the same as recreation or natural resources management," says Ken Soderberg, chief of the FWP Parks Division's Interpretive Services Bureau.



Bison jawbone from Madison Buffalo Jump State Park

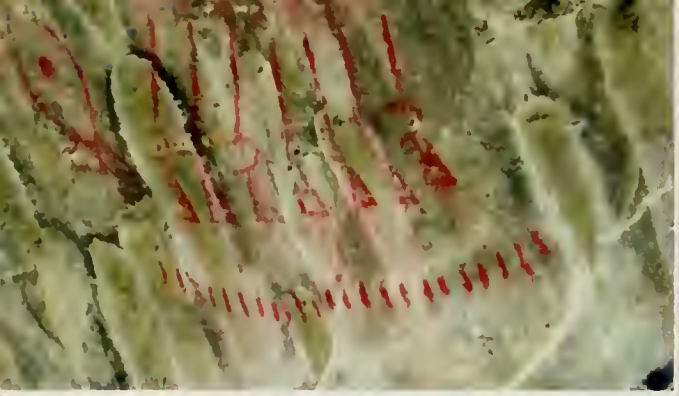
Lead or pewter Monopoly battleship game piece, produced between 1935 and 1941, recovered from Ghost Cave at Pictograph Cave State Park

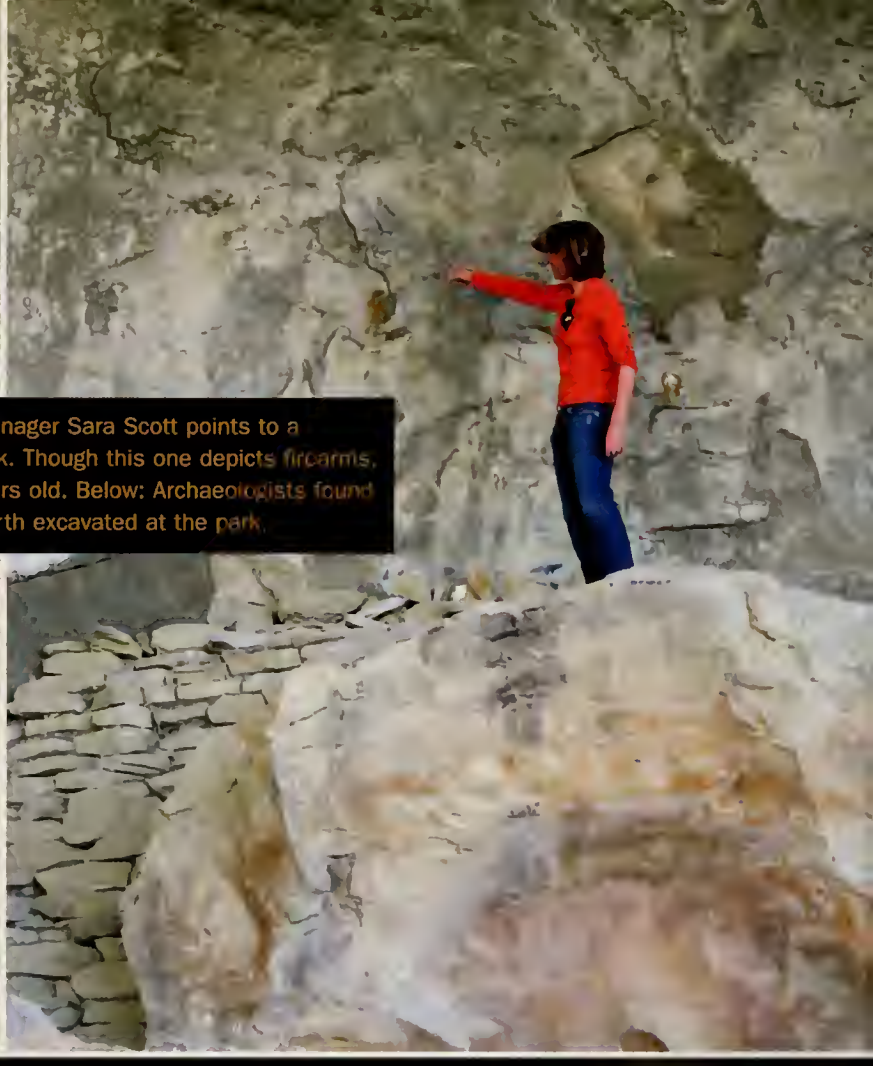


Blue Willow Ware bowl fragment from Fort Owen State Park

Spoon found at Bannack State Park

LEFT TO RIGHT: JOOY OURAN; AABERG CULTURAL RESOURCE CONSULTING SERVICE; MONTANA FWP; MONTANA FWP





LAYERS OF HISTORY Right: Heritage Resources Program manager Sara Scott points to a pictograph (closeup, above) at Pictograph Cave State Park. Though this one depicts firearms, some of the cave's pictographs are more than 2,000 years old. Below: Archaeologists found this 850-year-old charred bison bone in a prehistoric hearth excavated at the park.

BOTTLES, BULLETS, AND BAUBLES These glass containers, keys, and other old items were found at Bannack State Park. Other artifacts recently unearthed include the bullet casing from a .44-50 Henry Flat rifle, champagne glass shards, and children's toys. Seeing artifacts like these helps visitors imagine how people both young and old lived in this frontier gold mining town.

RICHER HUMAN STORIES

FWP's heightened cultural preservation work will also enrich the experience of park visitors. At Bannack, for instance, information about recently unearthed artifacts will be woven into visitor center displays and interpretive talks. The artifacts—including jewelry, beads, toys, and the bullet casing (which turned out to be from a .44-50 Henry Flat rifle)—will be catalogued and added to previously discovered treasures stored inside Bannack's historic buildings. Visitors will be able to peek through windows for a glimpse into the lives of people who lived there during the gold rush era. "History is typically written about great events and great people, but what we learn from the artifacts we excavate is about ordinary people in their everyday lives," says Dan Hall, lead archaeologist with Western Cultural. "For instance, toys indicate that there were kids in Bannack, which wasn't always the case in late 19th-century mining towns. Maybe some of the miners planned to raise their families there instead of just grabbing the gold and heading elsewhere."

> "I think their real value is when we can tie them back to the people who originally owned or used them. That's when it really becomes a human story that connects with our visitors."

Soderberg says state park visitors are hungry for such insight into the lives of people who previously lived in or used places that are now Montana state parks. "When you think of Bannack, typically it's of the prospectors who were digging for gold. But Bannack was composed of many other people who were just trying to eke out a living by selling merchandise, providing goods and services, things like that," he says. "So while the things we're finding are definitely important as historical artifacts, I think their real value is when we can tie them back to the people who originally owned or used them. That's when it really becomes a human story that connects with our visitors."

FOLLOWING

Biologists and volunteer

RAPTORS' UPS AND DOWNS

track the population fluctuations of Montana's birds of prey

BY RYAN RAUSCHER

"There's one," said my wife, Elodie, pointing to a speck in the distance. The distinctive silhouette of a soaring hawk was barely visible as it rode a midmorning thermal and circled above a nearby hill. She quickly mounted our spotting scope on the pickup window. "What's the one that makes a 'V' with its legs?" she asked while squinting into the eyepiece. "That's a ferruginous hawk," I said, glad she had learned a distinctive characteristic of the species, even if she didn't yet know its exact name. As she removed the scope, I tallied one more ferruginous hawk on the survey form. Six so far, a record for this route.

My portion of the annual Montana Raptor Survey Route, known as the RSR, has evolved into an enjoyable outing. It's a chance to welcome spring's return, see wildlife, and experience nature with my family. I took over the route several years ago when we moved to eastern Montana. Elodie is a quick study and has become a skilled spotter. The kids, when they accompany us, think it's great fun to spot a raptor before their parents do. Together, we join volunteers across Montana who also take part in the raptor count each spring.

The survey began in 1977 in response to alarming declines in raptor populations across Montana. At the time, it was widely known that bald eagle, peregrine falcon, and prairie falcon numbers had dropped drastically. But there was scant information on Montana's other birds of prey, such as the red-tailed hawk. Some populations seemed to be declining, possibly from DDT, PCBs, and other chemical compounds, as well as habitat loss and illegal shooting. But biologists did not know for sure and needed a reliable way to track populations and long-term trends. Over the past 32 years, information from the annual survey has been essential for tracking both the declines and increases in raptor populations and for better understanding the factors contributing to fluctuations. The data also acts as a scientific red flag that warns biologists of new threats or stresses to raptor populations.

TOM MURPHY

ONE, TWO, THREE... Since 1977, FWP biologists and volunteers have been counting bald eagles and other birds of prey across Montana to gain a better understanding of how raptors are faring.

CREATING THE SURVEY

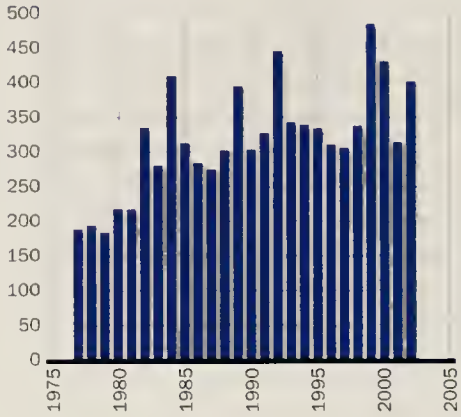
Dennis Flath, at the time the nongame wildlife biologist for Montana Fish, Wildlife & Parks, established the RSR. Now retired and living in Belgrade, he says he modeled it after a California raptor survey. Flath originally hoped to use the survey to determine raptor population sizes, but he found it was not possible. Instead the information works best as an index of long-term population trends. For example, though FWP cannot determine how many northern harriers live in Montana, the department can see from the RSR that harrier populations, on average, have slightly increased over the past three decades.

The RSR covers Montana along a network of road-based transects, each roughly 50 miles long, scattered evenly across the state. Each survey route crosses most of the habitat types—such as rangeland, forest, and wetland—within each area. An average of 65 observers complete 41 routes each spring between May 15 and June 5, identifying and recording all the raptors they see. In an average year, observers identify a total of 800 individual birds of prey belonging to 17 different species.

The survey is conducted in spring to count the number of birds returning to breed each year. "Counting breeding adults gives the most accurate picture of what raptor populations are doing," says Flath, who still drives a survey route in the Madison Valley each spring. "Survey too early and we'd miss birds that hadn't returned yet. Survey too late and many hens would already be on their nests incubating and not visible."

Ryan Rauscher, FWP northeast region native species biologist in Glasgow, coordinates the yearly Montana Raptor Survey Route.

Statewide raptor count 1977–2002



POPULATION INDEX This graph shows the number of raptors observed per 1,000 miles along 41 raptor routes across Montana. The annual counts don't tally statewide populations but rather trends of increasing, stable, or decreasing raptor numbers. Based on the survey results, raptor populations have risen steadily since historic lows in the late 1970s.

Half the routes are surveyed by citizen volunteers, most of them experienced birders and members of the Audubon Society. The rest are done by FWP, U.S. Fish & Wildlife Service, and Bureau of Land Management staff. "Given the expertise of the people completing the survey, I never worried too much about misidentified birds," Flath says. "But I always checked the data and questioned anything that seemed a little suspicious." Some survey routes, like mine, have become family outings. Others have turned into annual social events where birders gather each spring to share their passion for raptors.

IMPORTANT DATA

Engaging Montana citizens in scientific research is an important by-product of the RSR. But the project's primary value is producing valuable scientifically accurate information about raptors.

Take Swainson's hawks, for example. These midsized raptors migrate each year between their breeding grounds in North America to the deserts and open grasslands of South America. In the 1970s, Swainson's hawk populations were declining in other parts of the West; numbers eventually dropped so low in California that the hawk was listed as a state-threatened species. Was the same decline occurring in Montana? Before the RSR, biologists had no way of knowing. But now we can see that the Swainson's hawk population in Montana has remained stable over the past three decades. That means we do not need to take further action. If the population had been declining, we would have needed to initiate more intensive surveys to find out why. Then, with that information, we could fig-

"Survey too early and we'd miss birds that haven't returned yet. Survey too late and many hens would already be on their nests incubating and not visible."

1. LARRY DEARS 2. KEVIN R. FREDENBERG 3. MACNEIL LYONS 4. STEVEN AKRE 5. DENVER BRYAN 6. NELSON KENTER 7. GARYKRAMER.NET 8. TOM MURPHY 9. GARYKRAMER.NET

RAPTOR ROUTES

STATEWIDE COVERAGE The survey routes are spread evenly across Montana. Each is roughly 50 miles long and crosses the major habitat types in that area. Biologists and volunteers drive the routes between May 15 and June 5, identifying and recording each raptor they see.

MONTANA OUTDOORS SOURCE: MONTANA FWP

MANY DIFFERENT BIRDS OF PREY Observers taking part in Montana's annual Raptor Survey Route count 17 different species. Each bird has unique traits, such as the northern harrier's white rump or the V-shaped legs of the ferruginous hawk, which aid in identification. Some of the species tallied include:
1. rough-legged hawk, 2. red-tailed hawk, 3. golden eagle, 4. Swainson's hawk, 5. gyrfalcon, 6. merlin, 7. osprey, 8. sharp-shinned hawk, 9. Cooper's hawk.

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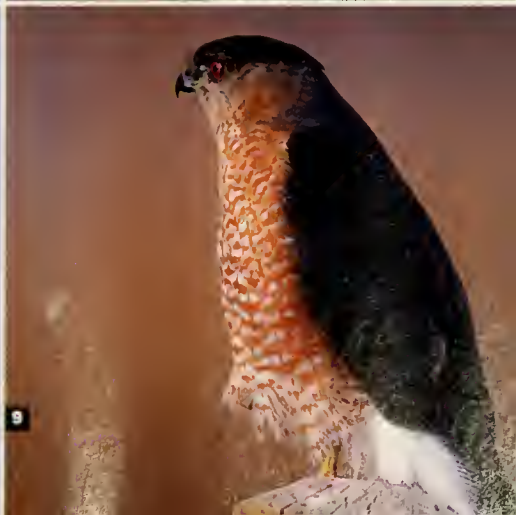
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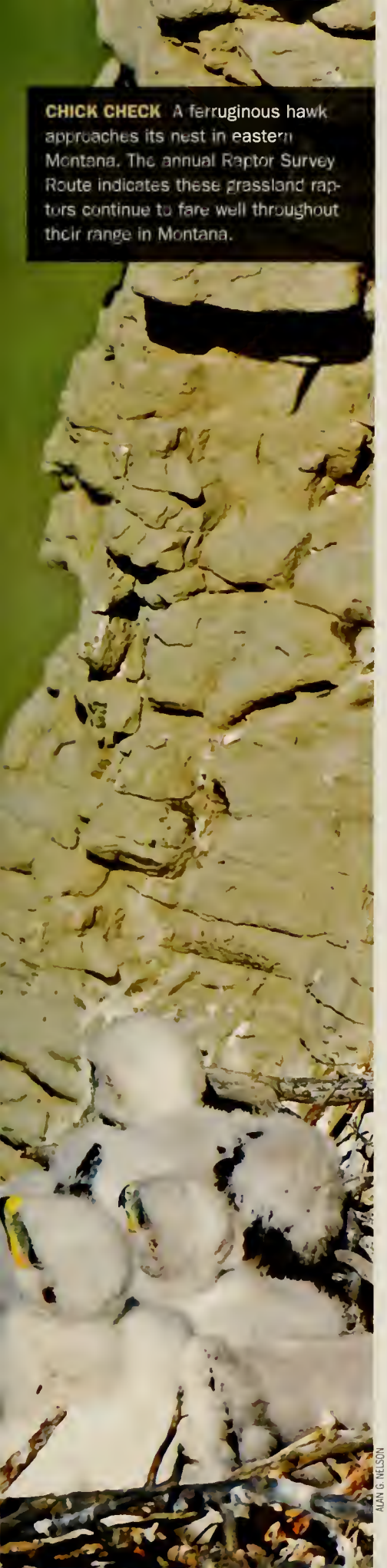


CHICK CHECK A ferruginous hawk approaches its nest in eastern Montana. The annual Raptor Survey Route indicates these grassland raptors continue to fare well throughout their range in Montana.

ALAN G. NELSON

ure out ways to mitigate the declines.

That has been the case with the ferruginous hawk. The RSR indicated a declining population trend, and in response biologists have begun studies to learn why. Another raptor species that may be faring poorly is the American kestrel. For unknown reasons, it has been showing up less frequently on RSR routes. If that trend continues, we may need to study kestrels more closely.

The annual survey routes also indicate that populations of some species are increasing. Osprey numbers, for example, are up, due in large part to the construction of nest platforms on power poles, which has greatly reduced electrocutions.

When Flath started the survey back when Jimmy Carter was president, approximately 200 raptors were observed per 1,000 miles of transect surveyed. Thirty-two years later, due to the DDT ban, tighter regulation of other chemical pesticides, and other factors, the number has more than doubled to 420 raptors per 1,000 miles. Raptors in Montana are generally doing well, and thanks to Flath and the more than 2,000 volunteers who have helped out over the years, we have the data to prove it.

No detours: 31 years on Route 41

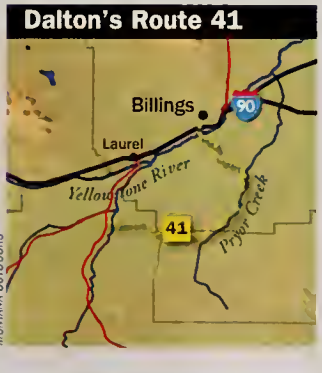
Volunteer observers are essential to the success of the Raptor Survey Route. These experienced bird watchers take pride in their routes and the accuracy of their observations. Since the survey began, 2,100 observers have documented and identified more than 25,000 raptors across Montana.

Jerry Dalton, an avid birder who drives a bookmobile for the Billings Public Library, has taken part in the RSR since the beginning. Dalton has been an observer on Route 41—which runs from Billings to Pryor to Edgar—for 31 of the survey's 32 years. During that time, he has driven more than 1,500 miles and observed 662 raptors belonging to 12 different species. Because of Dalton's diligence, Route 41 is one of the survey's most complete data sets.

BOB GIBSON/MONTANA FWP

RAPTOR SPOTTER Jerry Dalton readies for the 2009 survey, his 32nd.

Dalton's route takes him through habitat varying from prairie riparian to sagebrush grassland to hardwood draws. The raptor he has observed most frequently is the American kestrel. The one he has spotted least often is the osprey, which he saw only once. "I learn something new every time I do the survey," says Dalton. "It also gives me a chance to slow down and really enjoy seeing the birds, instead of watching them fly past at 60 miles an hour when I'm in the bookmobile."



What Dalton has observed on his raptor survey route since 1977:

- **303** American kestrels
- **2** Cooper's hawks
- **2** Ferruginous hawks
- **28** Golden eagles
- **63** Northern harriers
- **1** Osprey
- **3** Prairie falcons
- **8** Rough-legged hawks
- **193** Red-tailed hawks
- **5** Sharp-shinned hawks
- **7** Swainson's hawks
- **7** Turkey vultures
- **40** Unidentified raptors

TERRO
ON TINY

Insects, earthworms, and grubs beware: Shrews are hungry—all the time.

BY KERRY R. FORESMAN
PHOTOS BY THE AUTHOR, ALEXANDER BADYAEV, AND DONALD RUBBELKE

To gain a sense of what a pygmy shrew weighs, hold a penny in your hand. The coin tips the scales at 2.5 grams ($^1/_{10}$th of an ounce), while the pygmy shrew, one of the world's smallest mammals, weighs even less—not even 2 grams. In my laboratory, I have watched a 3-gram masked shrew attack a nightcrawler. The shrew is so small the worm can actually flip it over, like a man wrestling a 20-foot python. Tiny as they are, shrews are all the more incredible because they are true mammals, bearing live young and providing nourishment for their offspring with milk from mammary glands. They do everything humans do to survive—obtain food and water and care for their young—only on a much smaller scale, at a much faster pace, and with far more ferocity. »

EASY PICKINGS A dusky (montane) shrew prepares to eat a frozen dragonfly in a laboratory terrarium. In the wild, shrews also hunt and eat earthworms, spiders, and grubs captured on the forest floor.

R
FEET

IMAGINE YOURSELF EATING 50 POUNDS OF MEAT AT BREAKFAST, AT LUNCH, AND ONCE AGAIN AT DINNER.

If I took a survey asking which Montana mammal was the most ferocious, I suspect a majority would say the grizzly bear. They'd be wrong. Pound-for-pound (or in this case, gram-for-gram), shrews make grizzlies look like pet llamas. A shrew is almost always hunting. And each day it kills its entire weight in prey. That would be like a grizzly killing and eating a cow elk or two mule deer bucks every 24 hours.

Despite its remarkable predatory ability, the odds seem stacked against this ravenous, hyperactive carnivore. A shrew's small size makes it prey for owls, weasels, and snakes; it somehow has to survive winter without hibernating; it must eat every hour or risk dying of starvation; and the female has child-rearing responsibilities that nearly defy belief. "Like a street punk from a B movie, shrews grow up fast, live hard, and die young." I'm not sure who originally wrote this, but it is one of my favorite descriptions of shrews, because it's so true. For the past 30 years, I have been studying the ecology and reproductive biology of these species. I continue to be amazed at how interesting and unique they are, and yet how little any of us knows of these smallest of Montana mammals.

VORACIOUS APPETITE

Shrews are tiny animals with pointed snouts; small eyes and ears; long, hairy tails; and short, velvetlike fur. They are primarily insectivores, hunting and eating insects, earthworms, and snails.

Of the 33 shrew species in the United States and Canada, 29 belong to a group known as "long-tailed" shrews (genus *Sorex*). Ten of these shrews live in Montana, each with its own particular habitat requirements. The northern water shrew lives in fast-rushing mountain streams primarily in western Montana, while the light-colored Merriam's shrew prefers the arid sagebrush communities of the state's central and eastern regions. The dwarf shrew is found in high-altitude environments such as the Beartooth Plateau. Preble's shrews range from semiarid grass-sagebrush habitats to openings in subalpine coniferous forests.

Shrews have a voracious appetite. An adult kills and consumes, on average, its entire body weight in insects or other small animals such as salamanders every day. (Imagine yourself, if you are an average-sized person, eating 50 pounds of meat at breakfast, at lunch, and once again at dinner—and remember, you have to catch this food yourself.)

Though shrews lack the canines associated with carnivores such as wolves or mountain lions, they have unique teeth that function nearly as well. Two huge incisors, which protrude forward like buck teeth, allow the shrew to catch and hold prey. Behind the incisors are teeth called unicuspids that lack the elaborate cusp patterns seen in the teeth of other mammals. Farther back in the jaw is a full complement of crushing premolars and molars. These teeth have an unusual tritubercular (three-cusped) structure unchanged for more than 60 million years. It's one of several anatomical characteristics that make today's shrew nearly identical to those that walked beneath the feet of dinosaurs.

Ten shrew species live in forests and grasslands across Montana. The tiny mammals are also found worldwide, from the Arctic to the Middle East. Shown here: a bronze statue of an extinct shrew species found in an Egyptian tomb.

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CRAZY CARDIO

You'd think such a tiny animal wouldn't need much food. But with mammals, the smaller the specimen, the more calories it needs in proportion to its body weight to survive. Shrews have a phenomenally high metabolic rate because the surface area of their body is extremely large relative to their body mass, or volume. This causes them to lose a greater proportion of heat than is lost by larger mammals such as humans or even mice. As a result, shrews must ingest an enormous number of calories to offset their enormous energy loss.

To maintain its high metabolism, a shrew needs faster respiratory and heart rates to acquire oxygen and circulate it through the body. A resting shrew breathes approximately 800 times a minute and has a heart rate of 1,000 beats per minute. By comparison, humans breathe about 18 times a minute and have a resting heart rate of 60 beats per minute. I have listened to a shrew's heartbeat through a stethoscope, and it is a blur of patters, each beat nearly inseparable from the previous one.

Since the shrew's motto could be "Eat or die," it cannot afford to miss a meal or even a snack. Shrews must remain constantly active and vigilant for unsuspecting quarry, so they are always running from place to place. Just watching the frenetic creatures can be exhausting. Shrews don't even get a break in winter, because they are too small, and thus too hyperactive, to accumulate enough fat to hibernate, as a chipmunk or bear does.

I've long been interested in how shrews survive a typical Montana winter. I assumed they entered a state of torpor to reduce their caloric requirements. After all, how else could a warm-blooded animal that cannot hibernate, eats every hour, and requires an insect diet possibly live through the winter? Yet after extensive behavioral and physiolog-

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CLOCKWISE FROM TOP LEFT: DONALD RUBBELKE; ALEX BADYAEV; DONALD RUBBELKE; KERRY FORESMAN; KERRY FORESMAN; DONALD RUBBELKE

POINTY-SNOUTED PREDATORS Shrews are one of Montana's most common mammals, found throughout the state from moist meadows to alpine bogs to dry coniferous forests. Among Montana's ten species are the masked or common (above), pygmy (above right), and northern water (right). All species have tiny eyes and ears, a long hairy tail, and a pointy snout covered with long whiskers (below). Bottom: Red pigmentation is caused by iron deposits that harden teeth used to break through insect exoskeletons. Below right: The pygmy shrew, shown here actual size, is one of the world's smallest mammals. Its body is 2 inches long and it weighs only $^{7}/_{100}$th of an ounce—less than a penny.

THE FEMALE SHREW'S FEAT OF REARING ITS YOUNG CONTINUES TO AMAZE ME.

ical studies on shrews during the cold months, my graduate students and I have been unable to find evidence that shrews ever slow down. We now suspect that one way they survive Montana's -30 degree temperatures is by staying in the small, relatively warm space between the ground and the snowpack. They search for food in this insulated environment, which rarely gets colder than 35 degrees regardless of the air temperature above. Shrews also stay warm—and conserve precious calories—by growing a winter coat of dense hair. How they stay fed that time of year is still a mystery. Seeds and other plant material don't have enough protein, so shrews must continue to live on insects during the cold months. We suspect that overwintering grubs provide them with a rich source of fat and protein.

AMAZING REPRODUCTION

If a shrew survives the winter, its breeding activity begins in March and peaks in April or May. Most shrew species typically produce four to seven young after a 20-day gestation period. Young shrews grow extremely fast. The newborn masked (common) and vagrant shrews we rear in our laboratory grow to nearly adult size in roughly three weeks. The poor mother must produce milk for babies each growing to over 3 grams before they are weaned. That's 12 to 21 grams of babies fed by a female who herself weighs only 4 grams. As a longtime mammalogist, I know that animals can do some remarkable things, but the female shrew's feat of rearing its young continues to amaze me. What's more, females may even produce an additional litter during their second summer. Both males and females age rapidly and die in the fall. At just 16 to 18 months long, shrews have one of the shortest life spans of any mammal.

Though shrews are found throughout Montana, they are so small and well camouflaged by their gray or brown fur that people rarely see them. Those interested in watching shrew behavior should look under logs on moist forest floors dense with decaying wood and leaves. This habitat provides shrews with a rich source of insect food and ideal protective cover.

All shrew species have poor eyesight, but they compensate with keen senses of smell and hearing. They have long nasal passages, a flexible nose that constantly moves in different directions, and highly developed whiskers sensitive to vibrations in the soil. A shrew uses its snout to probe leaf litter or loose soil for worms or insects.

Some species, such as the vagrant shrew, may also find prey using a primitive form of echolocation. Like bats, these shrews emit high-frequency squeaks. We suspect that they can judge distance by hearing their ultrasounds echoing back from objects ahead of them.

I find all shrews fascinating but the northern water shrew particularly so. Common throughout western Montana, it is the largest shrew in North America. The species prefers watery habitats, especially cascading mountain streams. Northern water shrews forage underwater on aquatic insects and often build their nests on moss-covered rocks in midstream. Scientists suspect that this shrew has evolved to be larger than others to survive in cold water. (The larger a mammal's size, the less surface area it has relative to body mass, meaning less heat loss.) Unlike other shrews, the northern water shrew has long, coarse hairs growing between its toes. The hairs intertwine to create a weblike surface that powers the shrew's swimming strokes.

It's no surprise that northern water shrews have adapted to survive in their unique environments. That's true of all shrews. These tenacious little warriors evolved millions of years ago and have survived everything nature could throw at them, from ice ages to floods to supervolcanic eruptions. Yet here they remain, dashing back and forth across the forest floor at breakneck speed, hunting, always hunting.

DONALD RUBBELKE

READY TO EAT, AGAIN Due to a high metabolism that burns their entire body weight in calories each day, shrews must constantly feed on spiders and other insects. If they go for more than one hour without food, they risk starving.

ALEX BADYAEV

SAM STEWART, BONTERRA CONSULTING 2008

Western (Boreal) Toad *(Bufo boreas)*

By John Fraley

Western Montana is home to only one toad species, the western toad. (Montana's other two toads, Woodhouse's and the Great Plains, live east of the Continental Divide.) The Montana form of the western toad is known as the boreal toad. Along with two other subspecies, it is found across the Pacific Northwest from southern California to Alaska. In Montana, it ranges from the Idaho border to the Rocky Mountain Front and even farther east in the Little Belt, Crazy, and Absaroka mountains.

These plump toads are adaptable amphibians. I've seen them around low-elevation lakes and woods but also in the high country of the Great Bear Wilderness, at the top of Lone Man Mountain in Glacier National Park, and on Columbia Mountain in the Swan Mountain Range. In fact, western toads have been found living at over 9,000 feet in the Madison Range. Kirwin Werner, a herpetologist and senior author of *Amphibians and Reptiles of Montana,* has encountered them on the Continental Divide in Glacier National Park, 1,500 feet above any water source. "You wonder how they got up there," he says.

Appearance This squat, bloated-looking toad is 3 to 5 inches long. Its back is olive to brown, and the light green, whitish, or gray belly is covered in spots. A white stripe runs down the center of the back from the nose to the anus. The skin is covered with warts of various shapes and sizes. Females are larger than males and have a rougher and more blotchy skin. The boreal toad can absorb water through its smooth belly skin, and the humpy skin on its back prevents drying. Boreal toads have big, gogglelike eyes, with large parotoid glands behind their eyes. The glands secrete a milky substance that is toxic to many predators.

Sound Male western toads emit a series of high-pitched chirps, similar to the sound made by young geese. Herpetologists suspect the toads chirp to attract a mate during the spring breeding season or to tell other males to stay away.

Food Boreal toads eat flies, ants, spiders, and dragonflies. Adults occasionally eat young toads or other small amphibians.

Reproduction In spring, boreal toads breed in puddles and pond and lake shallows. A male grasps a female with his thumb pads and then mounts her. The female lays thousands of eggs in a long string, which the male fertilizes as they exit her body. The eggs hatch in a week or two. The small, dark tadpoles remain in large groups before dispersing after they metamorphose into half-inch-long young toads. The toads become sexually mature after about four years.

Habitat Boreal toads live in a wide range of wet habitats, including forests, meadows, uplands, and marshy areas at nearly all elevations. They are mostly nocturnal but can be found during the day in cool weather or at higher elevations. Boreal toads hibernate in winter. They hibernate—and find refuge from summer heat—under logs, in rodent burrows, or by burying themselves in soft duff or dirt, sometimes more than a mile from water. Boreal toads have horny tubercles on their hind feet that aid in digging.

Behavior Unlike frogs, which leap from place to place, boreal toads shuffle along or move in short hops. When handled or threatened, they puff up, urinate, or emit a foul-smelling secretion from their warts. The secretion deters most predators, though coyotes, raccoons, snakes, ravens, and crows have been known to eat boreal toads.

Status in Montana Boreal toads are found in many areas throughout western Montana, but no one is sure how the state's overall population is faring. Werner says that based on his observations, the population seems "fairly stable." But the Montana Natural Heritage Program notes that numerous surveys since the early 1990s indicate declining populations in some parts of western Montana. The state has listed the boreal toad as a "species of concern."

John Fraley manages the FWP Regional Information and Education Program in Kalispell.

PARTING SHOT

POSSESSIVE POSE

Demonstrating a behavior known as "mantling," a Harris's hawk spreads its wings and tail to hide freshly killed prey from other predators. See page 8 to learn how dedicated Montana falconers use these and other raptors to hunt. Photo by Kate Davis.

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